

Aviation Week

Including Space Technology

April 7, 1958 75 cents

A McGraw-Hill Publication

Air Force Unit
Backs Studies of
Space Problems

Sperry Sergeant Missile



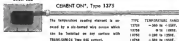
easily installed
factory calibrated

TRANS-SONICS

NO. 1-A

SURFACE TEMPERATURE TRANSDUCERS

actual view



CEMENT-ON™, Type 1375

This temperature sensing element is cemented to a polished metal surface which can be finished on any surface with TRANS-SONICS Type 446 cement.

TEMPERATURE RANGE	TEMPERATURE RANGE
1375	-200 to +1000
1376	0 to 1000
1378	+100 to 1000
1379	+100 to 1000

actual view



WELD-ON™, Type 1376

This temperature sensing element is welded to a 1/16 inch diameter metal wire, and is finished by spot welding the wire to the existing metal surface.

TEMPERATURE RANGE	TEMPERATURE RANGE
1376	+100 to +1000
1378	0 to 1000
1379	+100 to 1000
1379	+100 to 1000

- RANGE: From -200°F to +1000°F
- OUTPUT: Up to 5 volts without amplification
- RESISTANCE CHANGE: 100 ohms over full range temp.
- ACCURACY OF CALIBRATION: $\pm 1\%$ of range interval
 $\pm 2\%$ for temperatures over 1000°F
- MAXIMUM CONTINUOUS CURRENT: 50 milliamperes rms
- REPEATABILITY: $\pm 0.5\%$ of range interval
- VIBRATION: 5 shock double amplitude, 5-50 cps
50g 20-1000 cps
- ALTIMETER: 10000-15000 ft on all three major axes
- GLAZE: Two 4" axial wires with high temperature insulation

Trans-Sonics Cement-On Type 1375 and Weld-On Type 1376 Surface Temperature Transducers are platinum resistance thermometers that can be installed on any surface, flat or curved, metallic or non-metallic, for accurate temperature measurement. The protective cover of the sensing element is cemented or welded directly to the thermal surface to furnish an instantaneous signal which gives a transducer reading that corresponds to the true true temperature.

A 5 point zero-to-temperature calibration conforms to 0, 10, 50, 100, and full scale temperature is supplied with each transducer. A strip of aluminum "thermal tape" is also furnished with each unit to provide an accurate means of tape-on installation useful to 1000°F and under limited conditions to 1000°F.

Types 1375 and 1376 are the newest members of the Trans-Sonics family of platinum resistance thermometers for measuring surface temperatures. All units are capable of delivering up to 5 volts without amplification. Write to Trans-Sonics, Inc., Dept. 7, Burlington, Mass. for Technical Bulletin on Surface Temperature Transducers.

TRANS-SONICS

Precision Transducers

AVIATION CALENDAR

(Continued from page 5)

- Engineers, Colchester, Andover, Sta. Paul University, St. Louis, Calif.
- May 12-14—National Conference on Aeronautical Electronics, sponsored by Institute of Radio Engineers, Baltimore Hotel, Boston, Mass.
- May 12-14—Institute of The Aeronautical Sciences National Midwestern Meeting on Guided Missiles (Cheney, Hotel, Chicago, Ill., La. Mo.
- May 12-14—Aircraft Operations Council 11th Annual Meeting, El San Juan, Puerto Rico.
- May 14-16—Spring Meeting Society for Experimental Stress Analysis, Hotel Manager, Cleveland, Ohio.
- May 19-20—17th Annual National Conference, Society of Aeronautical Engineers, Inc., Belmont Plaza Hotel, New York, N. Y.
- May 19-20—Annual Aviation Science and Aviation National Fire Protection Association House, Chicago, Ill.
- May 21-31—1958 Aviation Week and Exposition, the Shermans Hotel, Houston, Tex.
- June 2-6—National Telecommunications Conference, Lord Baltimore Hotel, Baltimore.
- June 2-6—Radio Control and Conference on Avionics and Computers, University of Texas, Austin, Tex.
- June 4-5—West Coast Management Systems, coordinated program by the Society of Aeronautical Engineers and Foreign Engineers and the Management Association, Institute of Aeronautical Sciences Bldg., Los Angeles, Calif.
- June 5-12—Military Handling Conference, sponsored by Veterans Society of Mechanical Engineers, Public Auditorium, Cleveland, Ohio.
- June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D. C.
- June 23-25—1st Special Summer Program on Aviation Electronics, an introduction to the vibration problem in aviation and jet aircraft, Massachusetts Institute of Technology, Cambridge 38 Mass. For details write Dr. Stephen H. Crandall, Associate Professor of Mechanical Engineering, M. I. T.
- June 27-27—1st Transportation Conference, sponsored by American Institute of Electrical Engineers, Hotel Butler, Buffalo, N. Y. For information 2 38 Hewitt, East 42nd Street, Cleveland 1, Ohio.
- July 1-4-1958—Trans-Sonics, National Advisory Committee for Aeronautics (NACA) Aeronautical Laboratory Moffett Field, Calif.
- Aug. 1-12—Western Electronic Show & Convention, Institute of Radio Engineers (Aeronautical Hotel), Los Angeles, Calif.
- Sept. 1-5-1958—Aviation Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.
- Sept. 8-14—International Aviation Show, Coliseum, New York, N. Y.
- Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.
- Oct. 27-14th Annual General Meeting of the International Air Transport Association, New Delhi, India.

THOR

Thunder
of a
1,500 mile
thrust...



Preserver of Peace —

Offend U.S. Air Force Photo

The very heavens shake with the thunder of some 135,000 horses as Thor strikes across the sky at 10 times the speed of sound. Designed by Douglas Aircraft to deliver total destruction to targets as far away as 1,000 miles, Thor represents the Air Force's

striking arm where ground objectives are concerned. For this surface-to-surface intermediate range ballistic missile, with its inertial guidance system, RCA has developed and is supplying electronic units to help Thor declare its mission: the prevention of war.



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PHOTOGRAPHED ACTUAL SIZE
BALL ORBIT DIAMETER: $\frac{1}{16}$ inch



WORLD'S SMALLEST ball-bearing SCREW SOLVES CRITICAL MINIATURE POSITIONING/CONTROL PROBLEMS



LEFT TO RIGHT: A ball-bearing screw is applied to the drive of a 1/2 inch globe valve. One of the screw's self-lubricating ball-bearing grooves forms an integral ball-bearing track and enables the 1/2 inch globe valve to rotate 90 degrees.



RIGHT TO LEFT: A ball-bearing screw is applied to the drive of a 1/2 inch globe valve. One of the screw's self-lubricating ball-bearing grooves forms an integral ball-bearing track and enables the 1/2 inch globe valve to rotate 90 degrees.

An unprecedented achievement in minimum size and weight—maximum efficiency, dependability and service life for ultra-precise controls.

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Feature	Computer A	Computer B	Computer C	Computer D	LGP-30
Memory Size	256 words for data only	2560 words	1024 or 2048 words	512 words for data only	4096 words for data & program buffer or both
Max. Speed Add Multiply	20/sec 4/sec.	Comparable to LGP-30	Comparable to LGP-30	3/sec 1/sec.	Over 400/sec Over 50/sec.
Size	17 sq. ft.	6.5 sq. ft. plus table for typewriter	15 sq. ft.	3.3 sq. ft. plus table for typewriter & control unit	17 sq. ft.
Input/Output	Keyboard only... tape or radio unit	Keyboard (tape reader or printer at each end)	Tape and peripheral equipment required	Tape and peripheral equipment required	Tape typewriter for input/output... keyboard required to produce data... printer or multi-processor
No. of tubes	385	450	2100	240	110
Voltage	220 V	110 V	220 V	110 V	90V
Power	2.5 KW	3.0 KW	17.7 KW	1.45 KW	0.8 KW
Cost of programming & operation	Not significant. No external programs required	Alpha numeric or radio unit. It part... requires tape reader or printer	Alpha numeric or radio unit. It part... requires tape reader or printer	Alpha numeric or radio unit. It part... requires tape reader or printer	Alpha numeric or radio unit. It part... requires tape reader or printer
Cost	\$20,000 \$10,000/mo.	\$10,000 \$1,000/mo.	\$200,000 \$2750/mo. up	\$10,000 \$1,000/mo.	\$14,000 \$1,000/mo.

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RELIABILITY, ACCURACY IN

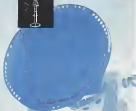
Nike Tracking Antenna Control Gearing... by Western Gear

The control gears and actuators provided by Western Gear for the U. S. Army tracker installations have for years provided nothing less than 100% reliability. In the intervening years Western Gear's engineering skill has moved forward with substantial progress in devising systems of advanced tracking techniques which will be "Tomorrow's Headline Story."

Western Gear's painstaking craftsmanship and technical production skill make us the logical source for the design and manufacture of inside components and complete systems... and blending of tomorrow's electronic marvels with the experience gained in 69 years of leadership in the mechanical power transmission field.



One motor powered gear drive



Here are the Western Gear control gears and actuators used at the missile tracking station... into the size of your finger nail, some 1/16" in diameter. All respond uniformly, accurately regardless of weather conditions, with 100% reliability.

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SEATTLE AND HOUSTON—REPRESENTATION IN PRINCIPAL CITIES

**tested...
tempered...
tortured...**

...and ready to be labeled RELIABLE.

The environmental test facilities at Bendix-Pacific are among the most extensive in the industry, simulating the rugged conditions under which tomorrow's components must perform.

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Take-off — the time when throttles are frowalled — when engine heat's near hottest. That's when aircraft oil must prove its dependability. *An engine's performance is only as reliable as the oil that lubricates it.* Today, 45% of the oil used by major scheduled airlines in the U. S. is supplied by Sinclair. There is no better proof of dependability.

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One in a series on how business aircraft are kept in top flight condition — and why these fleets, like the major airlines, prefer

CHAMPION SPARK PLUGS

Noted aviation authority reports on OHIO OIL'S

Winged Couriers of Industry

by HERB FISHER, longitudinal process analysis versus test pilot, under



Measures of Interest

Backbone of civil aviation's growth to 200,000 aircraft—a 400 per cent increase in 15 years—is “strictly business...business before pleasure.”

Of civil aviation's private flying fleet alone, which is 44 times larger than the 1,500-plane scheduled airline fleet, some 25,000 aircraft are "flying conference rooms," winged containers of industry.

Business flying is big business, expanding at a rate far outstripping that of commercial and pleasure flying. With one factory in three located in a small town off commercial air routes, business fleets are more than paying their way.

I've found few firms with business fleets and aviation departments comparable in size, scope and efficiency.

This company — with worldwide operations embracing exploration and production, supply and transportation, refining and marketing — is a natural for business flying. The

14th largest domestic crude oil producer among 12,000 concerns, Ohio Oil must integrate by fast flight a scattered domestic operation ranging from Texas to Canada, and



Suggest story: [Gangster-enraged Ex-felon files libel suit against police](#)

foreign exploration program stretching to remote corners of the earth.

Ohio Oil operates 23 aircraft, has 32 full-time pilots and co-pilots, nine skilled mechanics, and owns and maintains a modern airport at Findlay. Ohio, equipped to handle all types of aircraft, runways alone conform with the longest in the U.S.

Heading the company's 46 member Aviation Department is an old friend of mine from bungeejumping days — one Michael Murphy, dean of old-time stunt men, a decorated precision pilot and an aviation legend Mike set up Ohio CV's Aviation Department in 1945, after an Air Force career as lieutenant colonel in charge of glider fleets for General "Hap" Arnold.

Few U.S. corporations own and operate an airport with such complete hangar and shop facilities for maintenance, overhaul, and even conversion of its varied aircraft, as does Ohio Oil. And in every detail, this operation is different of its kind.

"Management wants nothing but the very finest case glass their phones absorb as well as on the ground," Mike told me. "We're directed to use only the very best in parts and equipment — thoroughly tested by us to meet our top standards for maximum safe performance in all operating extremes."

"That's why we've used Champion Spark Plugs, for example, for 10 years. We've found them tops in performance and dependability."

Other Oil aircraft, too, are selected for specific jobs — Super Ventures, DC-3's and C-47's for long hauls to far-flung ports not serviced by



They were last augmented by equipment. Arriving after the night work plug article. Mike Maury is (left) and (center) the (right) from "Various Film Book Vendors [1/1] and Co. (left) Maury's New Power (right) (left) (left) augmented with other work plugs through the years, always returned to Thomson.

sidelines, or for large groups wishing to hold conferences on route; Piper Tri-Pacers for pipeline patrol; Twin Benches, a Twin Benches, a Traveler and Bombers for heavier loads and feeder service to airline terminals; DeHavilland Beavers and Cessnas for ground duty.

"With our world-wide operation, traveling itself could be a full-time occupation for many of our personnel if we didn't have our own fleet," Mike said. "Management indicates that, without a business fleet, we would need considerably more high-salaried specialists and executives—and these are hard to come by. It's difficult to estimate the monetary value of increased production hours resulting from two-week-to-the reduced travel hours."

A case in point: For Oils Oil executives to get it one day's work at the company's Robinson, Ill., refinery, two days are spent in road-trip land travel. Champion-fired business aircraft, however, provide three-hour round-trip commuter service, enabling one man to cover

"We're not competent with the

contribution — split-second attention to various details of plane performance, terrain, turbulence. The pilot can take no chances of engine failure. Such rugged duty makes a mandatory, then, that the vital hours of the peepers' patrol phase be fixed to life day after day by Chompton.

Ohio Oil maintains small airports in remote exploration areas of South America and Africa. At Ohio Oil, Glass Oil Co. of Libya, for example, a C-47, Beaver and Otara carry supplies and personnel into regions previously accessible only by mule train or camel caravan.

Now, too, Champneys were safe
 flight over trackless wilds, when
 anyone would be far from an airport
 might mean the end . . .

At Findlay headquarters I saw flight crew—all in white dress shirts—handling passenger baggage.



Fast Results: Equestrian C-AT and haloperidol help relieve time-consuming problems—managing hot and grumpy and supplying OTCs (OTAs for long-term treatment).

passing plans, doing administrative work, grilling weather reports, mapping precise routes over back country, doing controlled work in plane interiors, checking and ordering replacement parts, performing all-around mechanics, designing their own executive plane interior equipment, sewing fabric and doing carpentry on interior woodwork installations—literally doing everything themselves...also flies.

"You'd have to screen thousands of pilots and mechanics to find any as qualified as ours," Mika told me. "Our men must be specialists in not one field but several."

It's a real tribute to Mike's management and experience—along with the performance of pilots, maintenance crews and aircraft equipment, such as Chempione—for Qiao Oil to have been honored by the N.B.A.A. for a perfect safety record—33,000,000 accident-free passenger miles.

CHAMPION SPARK PLUG CO.
TELECO 1-8880

Days away from : Students of field a full two hours from
flying headquarters via Chongqing and Lushan Express, and



In good hands – Skilled technicians ensure peak performance of Fiat & Volvo 4-111 Super Sprint engines with dependable Chiyosha.





IS YOUR PRODUCT MODERN IN EVERY WAY EXCEPT ONE?

Take clutches, for example—in aircraft plants throughout the country, modern Formsprag clutches have replaced old-fashioned ratchet and pawl mechanisms as well as their roller-type successors. This widespread change to Formsprag among designers is, in itself, proof of superiority. Consider, too, Formsprag's other advantages: the patented spring principle, which allows a Formsprag clutch to deliver more torque per cubic inch of displacement than any other power transmission unit available; ease of installation; and low maintenance cost. An additional feature of its modern design is simplicity, making prototype testing economical.

Remember, too, when it's time to replace your present power transmission—don't just replace—modernize with Formsprag. For complete information, send for a copy of the newest Formsprag catalog.



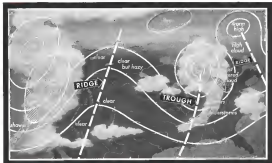
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Designers, engineers and manufacturers of the modern spring type over-running, locking, and free-wheeling clutches for aircraft, automotive, and various industrial applications.

FLY WEATHER-WISE

These weather items prepared in consultation with the United States Weather Bureau



CIRCULATION PATTERNS

Counterclockwise flow around High Pressure areas and clockwise flow around Low in the northern hemisphere are well known to most pilots. However, there are some lesser-known features of Highs and Lows which have become apparent with the progress made in report analysis.

Warm Highs—Extend to levels above 10,000 ft. with temperatures generally warmer than the local atmosphere. As this type of High extends further aloft, it often assumes an elongated shape with major axis lying N-S to form a Ridge. This Ridge usually shows very slowly blocking outward movement of weather systems

at lower levels, often causing prolonged periods of fair or rainy weather in adjacent areas. Weather in warm Highs is usually dry, fair and often hazy.

Cold Lows—Extend to high levels with temperatures generally colder than the local atmosphere. These cold, renewed movements aloft and sometimes the cross axis, becomes stationary or even elongated westward. This is called a Cold Low because of concentration of cold temperatures near the center. A slanted elongation of these Lows toward the south is referred to as a Trough and marks regions of wind shear and possible clear air turbulence.

FORECAST: Top Flight Performance with Mobilgas Aircraft and Mobiljet fuels!

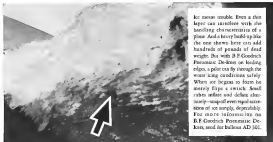
For piston engines: Mobilgas Aircraft helps assure availability of full power from takeoff to landing.

For jet engines: Mobiljet fuels available for sale wherever in-flight refueling conditions. They flow smooth under all conditions. Excellent thermal stability.



You're
Miles Ahead
with Mobil!

B.F. Goodrich De-Icers could have prevented this



B.F. Goodrich Plyheat could have prevented this



B.F. Goodrich aviation products

A Sound Space Program

After a winter of ferment and indecision, the first days of spring have produced a series of actions that promise to put the military weapons development program in general and the space exploration program in particular on a sound basis for accelerated action. We would be lost (and because it is so neglected the opportunity to point with a little pride to the fact that each of these recent decisions by the White House and Pentagon followed the courses we have tried for editorial in recent months.

They are:

- **Presidential recommendation** of the National Advisory Committee for Aeronautics as the nucleus of the new National Aeronautics and Space Agency to spearhead the U.S. drive to useful space.
- Our editorial, "NACA, the Logical Space Agency" (AW Feb. 3, p. 21) was widely used in the congressional debate on this subject as both House and Senate.
- **Army decision** to switch from its annual concept of missile development in awarding a weapon system type development contract to the Martin Co. for its new solid fueled Thorball missile. We noted the Army annual development concept in a series of editorials last fall, "Missile Misadventure" (AW Sept. 9, p. 21), "The Missile Industry, Milk" (AW Sept. 16, p. 21), "Who Really Develops Missiles" (AW Sept. 23, p. 21) and "Perspective on Missiles" (AW Sept. 30, p. 21).

In these editorials, we argued that the annual concept was hopelessly inadequate to cope with modern weapons development problems. We noted that the Army was doomed to technical setbacks until it understood its development concepts. We strongly suspect that the role of the Thorball missile by top-level Army leaders when the Douglas Thor and the Redstone Arsenal (Japan) were evaluated side by side last winter convinced them of the wisdom of the weapon system concept and also stimulated Winston W. Brown's letter public denunciation of it in Los Angeles recently.

- **Presidential authorization** for a new guide launching by USAF and Army. This announcement last week confirmed an exclusive Aviation Week story in our Jan. 20 issue, page 36, detailing the use of the Douglas Thor as a first stage plus Vanguard second and a newly developed third stage. It is certainly a rare decision to proceed with the initial space exploration program that can be implemented in the immediate future using adaptations of existing hardware rather than allow the entire space program to stagnate while the administrative reorganizations required are being finished out.

It is apparent that the addition of Dr. James H. Doolittle, Jr., president of the Massachusetts Institute of Technology, to the President's staff as his scientific adviser has had a salutary effect in moving the executive branch of the government into bolder and more imaginative action than was apparent during the first few post-Sputnik months. The President's space agency proposals also recognized the fact, often deliberately overlooked by the "military fringe of space critics," that the exploration of space must include the problems of getting in and out of the earth's atmosphere envelope safely and efficiently.

It would serve little purpose here to repeat the details of our strong endorsement of NACA for the space or earth role in the Feb. 3 editorial "NACA, the Logical Space Agency." We strongly support the President's space agency proposals and eagerly recommend that the leaders of the aviation industry and the scientific communities associated with accelerated development and its expanding technologies get behind this proposal and give it firm and unequivocal support when the subject is debated before the appropriate congressional committees.

It is fortunate and a good example of the flexibility of the legislative branch of the government that both House and Senate have organized special space committees to consider the best of new problems raised by this endeavor. The men serving on these committees have been well selected from a background of military and fiscal experience on Capitol Hill and should be capable of better consideration of space problems than any of the traditional legislative groups.

Inevitably, some opposition will develop to the President's space agency proposal although there is no indication that it will be along strictly political lines. Rather, it is likely to come from individuals who had alternate proposals on how to best handle the problem.

Perhaps the kindest criticism to be voiced by the new space agency will not be technical but in seeking out a sound relationship with the military services interested in space weapons and the industry that has traditionally shouldered the space development load. But perhaps the strongest argument is giving NACA the new space job it is solid record of more than 40 years of handling these complex relationships on an effective basis through the dynamic technological revolutions that brought the airplane from sparrow, cannon and biplane to the standard steel, 2,000 mph, piston vehicles of today that already have crested even to the edge of outer space.

—Robert Hertz



MOBILE COMPONENTS Above, safety and timing systems protect ground air and are given from test to launch idea take over in flight. Safety factor of one in a million is specified and reliability dependent by Bulova's precision, perfecting facilities. Powerhouse design and timing systems are strong after Bulova developments for 12 key missiles.



AIRCRAFT INSTRUMENTS Below, a new Bulova Atomic design modernizes reliability through improved accuracy, reliability and control safety. An air (60) test, a device (60) test, is tested in 60 test. Safety is improved in traffic control and flight test aircraft tests. As a second instrument, it is mostly reliable in guided missiles.

Bulova reliability helps to solve today's most challenging problems

For more than 50 years, Bulova has charted new courses in the area of reliability.

Milestones along the way are the electronic and electro-mechanical devices created by the Bulova company—the tremendous blend of pioneering ideas and precision production techniques.

These Bulova developments, distinguished



by their advanced design and consistent high performance, help our nation's defense and industry solve solid claims on the frontiers of science and space.

The high degree of Bulova reliability provides from concept to mass production. For assistance with your systems and component problems, write: Department G-12, Bulova Corp., Jackson Heights, New York.



MINI-MINI COMPONENTS Bulova mini and mini size progress to develop high grade Switzerland by design. Bulova improved production processes increase yield and product reliability. Other mini developments include atomic, repair and electronic instruments as well as advanced research in atomic and lead electronic aids.



PHYSIOGRAPHIC SYSTEMS Bulova's new high performance clock miniatures include B-1000 series, and pulse counting—utilizing time accuracy to (1000) sec. From the smallest three gun camera over built to units of 1000 test rate Bulova developments include optical, data recording and instrumentation, and special sequence cameras.

WHO'S WHERE

In the Front Office

William J. Hagan and **Charles A. Klein** chairs, American Airlines Inc. Jack S. Winkler, executive vice president and chief executive officer, American Express Co., Santa Monica, Calif. **Alvin Robert E. Fink**, vice president-operations, and **J. M. Wright**, vice president-operations.

Alvin L. Schermerhorn, executive vice president and a director, Atlantic Corp., St. Louis, Mo.

George W. Chase, vice president man agent engineering, Radio Corporation of America, New York, N. Y.

Dr. Robert M. Rosen, vice president, Syracuse Research Laboratories, division of Syracuse Electric Products Inc., New York, N. Y. **Alan Melvin E. Lott**, manager, Radio Systems Laboratory, Syracuse Electronic Systems.

John E. Stahlberg, vice president, Air Research International Corp., New York, N. Y.

Leslie G. Winkler, a vice president, Time-South, Inc., Burlington, Mass.

Paul G. Chalkin, assistant vice president traffic and sales, Capital Airlines Inc., New York, N. Y.

Reg. Gen. Richard W. Howard (DIA/C-1), has joined the staff of American General Corp., Aurora, Calif. **Gen. Howard** is at work with the planning and design of the Pacific Missile Range.

Mr. Gen. Leighton I. Davis will become Deputy Commander for Research and Development Headquarters, Air Research and Development Command, Andrews Air Force Base, Md. **Reg. Gen. Daniel E. Hoyle** will succeed **Gen. Owen C. Cummings**, Chief, Air Force Missile Development Center, Holloman AFB, N. M.

Honors and Elections

Reg. Gen. M. S. White, Director of Medical Branch and Pharmacy for the Surgeon General, USAF, has been elected president of the Aero Medical Assn., Washington, D. C.

Dr. Charles C. Lundberg, Professor of Physics at the California Institute of Technology, has received the second annual Capt. Robert Dexter Cassin Award as selected by the Office of Naval Research, for outstanding contributions to the Navy's research and development program in the field of rockets, jet-engine physics and nuclear operations.

Mr. Ross C. Sigbee has been selected as Governor, Los Angeles County for 1958 by the Geographic Research Directorate, Air Force Cambridge Research Center, Bedford, Mass.

A. Wilson Lind, vice president advanced planning and government relations for The New York Air Radio Co., has been appointed to the Board of Governors of the Newark Institute, New York.

C. J. Rouse, president of Connecticut Mason Corp., has been appointed to the National Advisory Committee of the National Academy, Committee for Aerodynamics (Continued on p. 94).

INDUSTRY OBSERVER

▶ Martin Denver's Titan intercontinental ballistic missile is a three-stage, three-segment vehicle. First stage has two engines, second stage a single engine, third stage none. However, fourth engine can be installed on the third stage at a later date if necessary. Reasons for separating the second and third stages, although the third is unpowered, is because re-entry problems would be encountered at a large second stage—about 16 ft. long—measured attached to the nose section. Separation of second and third stages is accomplished by venting residual liquid oxygen from the second stage supply tanks at a pressure of about 15-40 psi. Through two vent valves Valves are placed diametrically opposite each other at the outer edge of the front of the second stage and are crated outward second stage from the nozzle's center line. Flow of liquid oxygen escaping through vent valves gradually slows down the second stage and gently separates it.

▶ Novel guidance technique in which the missile responds directly to voice commands received by a human operator watching its flight on a radar screen has been developed by Martin's Orlando Division. Technique, possibly developed for one with Martin's Reduplex guidance system, Navy plane, when upon the fact that certain sound and vowel-like sounds are almost identical for all audio waves. Development has included the stage where guidance receiver can recognize at least four different commands from all audio tones tested.

▶ Major improvement in accuracy of aerial gunnery guns and guidance systems, representing perhaps as much as a 10-fold gain plus improved reliability and life, is expected during the coming year as a result of new methods and techniques being developed for manufacture of precision bearings.

▶ Office of Naval Research plans to send a 16-in. telescope to an altitude of 100,000 ft. in a balloon for astronomical observations above the earth's atmosphere. Pictures of the sightings will be transmitted back via television. The relatively small telescope, due of atmospheric haze, is expected to produce results equivalent to the 200-in. Mt. Palomar telescope.

▶ North American B-50A Dog electronic countermeasures missile to be used by the Boeing B-52 and McDonnell's B-57C aircraft. North American's B-50A, which also built the inlet controls for the North American F-107, is building the controls for these two projects. First F-107, powered by General Electric J79s, is scheduled to roll out in 1958. Design speed is Mach 2.

▶ Air Force, following Army's mounted experiments with study of the regular nose cone, is looking toward plastics which ablate (are removed) at Mach 2 and 3 re-entry speeds as a possible solution for problems confronting aerodynamicists building nose cones. Plastics being used are made of organic materials. Cone will begin sliding evenly at temperatures of approximately 800°.

▶ Mixed Space Flight Division has been established at Air Force Flight Test Center, Edwards AFB, Calif. Group will work on areas of pilot flight controls and displays in addition to other aspects of manned space flight.

▶ Photographic collector sampling long test vehicle developed by the French engine from Suez to Zhukovskiy, patch is now being assembled. Aircraft will be airborne and be light tested as all flight regimes between vertical ascent and descent and horizontal flight. Success is pending next development for jet engine designs to follow this prototype.

▶ Need \$8-11 missile has been tested on the Donnell Thurston, St. Anthony's Alouette helicopter and Chance Vought Corsair for operational use against ground targets. War-controlled missile is a development of the late \$8-11 anti-tank missile recently sold to the U. S. Seventh Army in Germany.

▶ New's Polaris fleet ballistic missile will carry a hydrogen warhead.

THE PRODUCTS OF THE MIND

The world we live in is in large part the product of the scientific thought and accomplishment of the past, transmitted into engineering achievements. Whether we continue to go forward depends on whether the scientific curiosity, the imagination, the careful thought, and the logical analysis of the past, upon which today's technical achievements were built, can exist and flourish in the environment of the new world.

At Avco Research and Advanced Development Division, and at other places in the free world, an atmosphere exists in which the inquiring mind may live and create. We have the technical assistance and the facilities by which ideas are converted into concrete accomplishments. Many things have been done, and infinitely more remain to be done—the world of scientific thought is unending and promising. From the products of the mind will come the technical world of tomorrow.

Samuel L. Simon

Dr. Samuel L. Simon
Assistant to the President



Dr. Samuel L. Simon



Featured above is one of the Research and Development Center area code contractors in Wilmington, Massachusetts, identified for copyright this year, the advanced laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.

Avco Research and Advanced Development Division now offers continued and exciting career opportunities for exceptionally qualified and forward-thinking scientists and engineers.

Write to Dr. E. W. Johnson, Research and Technical Services, Avco Research and Advanced Development Division, 20 South State Street, Lawrence, Massachusetts

Avco
Research & Advanced Development

Washington Roundup

BuAer Overdraws

Naval Bureau of Aeronautics, faced with the prospect of overhauling its Fiscal 1978 funds in several hundred million dollars at present spending levels, is cutting back on progress payments to contractors and keeping a tight rein on expenditures in general. Previous rumors for funds shortage apparently were the bureau's failure to evaluate aircraft. The report on demands for funds to cut lead times would have no expenditures in some instances the bureau is asking its contractors to accept delayed small progress payments until the end of the fiscal year. Some small contractors won't receive any progress payments until after July 1. Still other firms are being asked to defer billings until the beginning of next fiscal year.

USAF Record Splurge

Watch for the Air Force to blow away a string of record breaking flights aimed at bringing all piloted flight records to come under its banner. Achievement of a KC-135 tanker to be moving from Tokyo to Madrid, getting a longer boost from the high altitude jet stream, will be the first effort aimed at shattering the Navy's 11,736 airman record now on the books and set by the Lockheed F-4 Phantom II in 1948. Lockheed's 1314 will attempt a world speed record boost over the 1,397.6 mph mark set last July by the McDonnell F-101 and try to match the altitude record held by the British. Record-setting altitude record for aircraft is now 70,308 ft set by an English Electric Canberra powered by British Olympus engines.

Electronics Buying

Development of a federal avionics acquisition system will be pushed to stimulate the electronics industry. Legislation introduced by the President and passed through Congress last week authorizes Civil Aeronautics Administration to purchase up to \$50 million in air navigation equipment, largely avionics, in the next 30 days. This is part of the \$505 million for air navigation equipment program authorized for Fiscal 1978 which began July 1.

The President and the Appropriations Committee finally explained that the reason for the legislation authorizing avionics program is to push forward their equipment buying program in "to stimulate business activity and competition." The measure would authorize Avionics Manufacturers Board to promptly launch a \$4 million buying program.

Congressional Outlook

More are developments to expect from Congress. • **Procurement investigation.** House Appropriations Committee is making an investigation of avionics procurement practices in connection with consideration of the Fiscal 1979 defense budget. • **Appropriations.** Senate Commerce Committee will open hearings April 14 on legislation to make an "emergency" \$75 million in federal funds immediately available for airport construction. The measure also would increase the federal allocation, starting with Fiscal 1980, from the present \$45 million annually to \$300 million. With \$10 million from local communities, this would mean an annual development program of \$310 million.

• **Military Air Transport Service.** Senate Commerce Committee will start hearings on MAATS' operations with commercial air carriers April 16.

• **Small Business.** A Senate Small Business Subcommittee has scheduled hearings April 15-17 on delays, purchasing policy as it affects small firms in the fields of medical supplies, rockets and auto parts, explanation. Defense witnesses include William H. White, Defense Department director of small business; Ken W. Johnson, director of the Advanced Research Program Agency; and Maj. Gen. Bernard A. Schriener, commander of USAF's Defense Research Division.

Killian's Secrecy

Rep. John Mann (D-Calif.), chairman of the House Government Information Subcommittee, is challenging the reasons given by Dr. James Killian, the President's scientific adviser, for keeping tight secrecy on the names of the special advisory panels by establishing from time to time to review controversial defense projects. Dr. Killian explained: "Now."

"Most of the panels are composed of persons going out of existence once they have made their report and recommendations. To identify the panels and their membership would be to disclose which problems and scientific research areas are of the highest priority to the administration—use of current interest to the President."

In response, Mann has asked Dr. Killian whether the President as Killian said the decision to withhold the information Mann added: "It also would be like to know whether it is your personal conviction, as a scientist as well as a government official, that release of information on the composition of advisory panels would constitute a threat to the public interest or national security?"

New Local Service Interest

Guaranteed loans and capital grant bills recently passed by Congress have opened a new interest in local service centers among aircraft and engine manufacturers. The new sources of money resulting from these bills, coupled with an urgent need by local service centers to replace the discontinued DGC's with more modern equipment, have suddenly established the small centers in significant national contracts. Martin Marietta, the Los Angeles, Calif., of the Avco of Local and Federal Airline Air is evaluating two major engine manufacturers and four aircraft companies who will develop their products to address local and officials. Most contract order that benefits of the capital grant bill will be significant under DGC's firms are turned over immediately before the market is placed with second-hand transports.

Retirement Penalty

Members of House Armed Services Committee are considering amending legislation that would penalize members of the armed services retired in government service who retire at an early age. Rep. Louis Armistead (R-Fla.), ranking minority member, indicated at a hearing that the need for it "has been emphasized by the retirement of certain officers in recent months."

Members are also considering a measure which would require members of the military to serve a specified period of time in the military service.

—Washington staff

NACA to Spearhead U. S. Space Drive

By Robert Hlatky

Washington—National Advisory Committee for Aeronautics will get the major role in developing a national space technology program under proposals submitted by Congress last week by President Eisenhower.

The President recommended creation of a new agency, the National Aeronautics and Space Agency, to do basic research and development for both military and civil applications of space technology, and to organize and operate the civilian aspects of a space exploration program. Nucleus of the new agency would be the scientific staff and research facilities of the NACA. Draft legislation detailing the proposals was sent to Congress by the Department of Defense. A fiscal 1959 budget proposal to finance the new agency's initial operations was being prepared for Congress.

The President's space plan called for a merger of the research and development and advisory committee in the NACA. The new agency would be headed by a director appointed by the President subject to Senate confirmation. Directors of NACA is now headed by the 17-man advisory committee whose members are appointed by the President. Under the new proposal, the 17-man advisory committee would still be appointed by the President with nine representatives from civilian members and eight members from government agencies most concerned with aeronautics and space technology of which "at least one member should be appointed from the Department of Defense."

This committee would serve as a steady advisory committee to the director rather than as the policymaking group as it does now in NACA. James Harold Doolittle, retired USAF general now a vice president of the Bell Oil Co., is currently chairman of NACA and Dr. Hugh L. Dryden is director. Although no names were mentioned in the President's message to Congress, it is widely assumed that both Doolittle and Dr. Dryden will continue in similar roles in the new agency. Advisory committee membership will probably change in certain categories to reflect space activities the new agency's role.

Among the principal points regarding the new agency in the President's message were:

- National Aeronautics and Space Agency "should be given that authority which is well needed to administer successfully the new program and conditions that exist now be fully recognized."

- All research of the NACA "will immediately be transferred to the new agency" on execution of legislation creating it.

- The scales for scientific personnel in the new agency will be exempt from existing Civil Service regulations to permit hiring of the best available talent at rates comparable with industry.

- Department of Defense and NACA are now conducting a review of all space projects to determine which ones should be transferred to the jurisdiction of the new agency.

- Preparation of an organizing plan for the new agency by Department of Defense and NACA to "secure support of the new agency by organizations, facilities and other resources of the Department of Defense either by cooperative arrangements or by transfer to the new agency."

- Preparation by NACA of detailed plan "as may be required to prepare for the transfer to the National Aeronautics and Space Agency of the responsibilities now assigned for it. These plans are to set forth the specific new space program to be initiated and to describe the internal organization, management structure, staff facilities and funds which will be required." The President specified that NACA is to direct those plans with the National Science Foundation and the National Academy of Sciences to "formulate the scientific objectives of our space program."

The President's proposals show the results of the review by special interest groups. Dr. James Kilgus, president of the Massachusetts Institute of Technology, and the aerospace staff assembled for the job.

Although all final plans for the new agency are contingent on the specific type of legislation endorsed by Congress, some of the broad areas in which the new agency will move are apparent. They include:

- Creating an advisory committee for research and development work that NACA does not now possess. Initiatives here are this will be done by a contract with a civilian research organization rather than by building and staffing a new NACA facility.

- Extensive contracting program with industry, research foundations and universities. These contracts will fall into three categories: basic research and development, primarily with universities and foundations; development hardware contracts with industries; and laboratory research contracts such as the computer research for the Air Force.

- Expansion of NACA's existing facilities to cope with the new role. For example, the missile test motor at Wallops Island, Va., will undoubtedly be greatly increased in capacity both for launching research vehicles and development of hardware for space exploration. NACA's Space Technology Committee created several months ago already has been studying the requirements for a launching base for exploratory space vehicles with a view toward determining the possibilities of the best location for a base of this type close to the equator. The equatorial Plant for launch and other types of space probes in the next 15 months will undoubtedly use existing facilities at Cape Canaveral, Fla., or at Cape Cod, Calif. Jet's new launching site for space vehicles probably will be included in the new agency's program.

- Continuation of the NACA's basic research and development on manned space exploration, including the use of the hypersonic for the Air Force, Navy, Army and civil aviation.

NACA has been increasing its research base since 1952 to include a heavier role in space technology in such areas as the X-15 manned space research vehicle program, the rocket problems and acceleration testing, new propulsion systems including solid propellant, surface propulsion and high energy fuels, and spacecraft propulsion. However, under the new plan proposed by the President, NACA will have to expand its activities heavily as the development role of the program will enter into the operational field for the first time with responsibilities as the main exploratory vehicles in the civil space of the space program.

The President's proposals for the National Aeronautics and Space Agency are expected to meet little opposition in Congress. Biggest congressional action will be taken in a specific plan of action with a preliminary legislative program requirement which the NASA plan calls.

Opposition plans that gathered some momentum in the vacuum created by the absence of a specific White House proposal are expected to evaporate with the appearance of this legislation. Besides the Atomic Energy Commission and a cabinet-level Department of Science to do the job are pretty well overruled by the NASA plan. Biggest opposition is likely to come from agencies of the scientific community who hoped for a completely new agency that would allow research jobs to be given to newcomers in the field.

One major unresolved question is the status of NACA in the Advanced Projects Research Agency of the Defense Department. It is unlikely that this relationship will be clarified until the status of ARPA is clearly defined in the Defense Department reorganization proposals submitted to be submitted to Congress by the President shortly. However, creation of the NACA is expected to eliminate much of the originally planned need for ARPA and strengthen the traditional close relationship between NACA and the three services.

The President said that, pending enactment of legislation creating the new agency, he had approved certain proposals for attack and lower probe launching under the direction of ARPA. He also said that, when the new agency was created, it would review these projects to determine which should come under its jurisdiction and which should continue under the Department of Defense. He indicated that the Defense Department would continue to be responsible for space activities pertinent to be associated with military weapon systems or military operations. However, NACA in the past has provided a broad research foundation for military aerial weapons systems development and will undoubtedly continue in this role in the future with space launch vehicles on contract operations.



Ventral Fins Mark F8U-2

Most recent changes on Chance Vought's F8U-2 Corsair are addition of two ventral fins and two airbrakes mounted on the wings near the vertical fin for additional control. Examples of the new version is the F8U-2B Whiskey J17 (left) shown. First prototype (left) still carries the F8U-1 designation underneath rib tail. Note antenna system (lower) that houses which was left exposed. Right shot shows second prototype.



President Requests Additional \$1.6 Billion for Fiscal '59 Defense

By Katherine Johnson

Washington—Additional defense funds of \$1.6 billion for fiscal 1959 approved by the President last week total \$300 million short of Defense Department requests. A total of \$1.5 billion was submitted to Congress by the President. Another \$115 million will be added to the nation's public works budget. Major projects to be financed with supplemental funds are:

- **Boeing B-52 Bomber-KC-135 tanker program.** \$400 million to \$500 million. This is for B-52s which will continue production through the 1960 calendar year, and KC-135s. It will add one B-52 wing to replace a medium range B-47 wing, increasing the number of B-52 wings from 11 to 12. USAF has also ordered 12 new B-52 wings, and that 14 wings at the minimum have bomber equivalent. Financing for 602 B-52s and 400 KC-135s previously had been provided.
- **Advanced missile program.** \$10 million. This is for Army's Nike Zeus and Thor programs.
- **Titan intermediate-range missile program.** \$10 million to \$30 million. This is to accelerate development and provide for base construction—either one underground base or two above-ground bases. Gen. LeMay had asked \$125 million and intended to push work on the Titan booster stage.
- **Minuteman anti-ballistic missile missile program.** approximately \$180 million. This will accelerate develop-

ment of USAF's solid propellant ballistic missile program.

- **Honored Dog, approximately \$100 million.** This will provide for the first major production order to North American Aviation for the electronic countermeasures missile to be used by the B-12. Previous financing totals approximately \$100 million.
- **Polish test balloon missile program.** \$150 million to \$300 million. This includes funds for two additional medium-powered Polaris submarines and the vessels to equip them. Three Polaris submarine programs have been possible, making a total program of five. Navy had tagged a program of nine.
- **Pacific Missile Test Range, Pt. Mugu, Calif., \$30 million.** This will finance construction of the easternmost end of the eastern tracking range across the Pacific, including construction of some tracking vessels.
- **Advanced missile program.** \$110 million to \$125 million, including 54 missiles for ASW attack.

Sen. Henry Jackson (D-Wash.), chairman of the Atomic Energy, Military Applications Subcommittee, commented that "it is inconceivable that the administration would order less than one complete wing of B-52s, which will spare about 52 planes, and the 35 KC-135 makes a world record to support a full wing of B-52s at the rate of one tanker for each bomber."

Jackson also pointed out "equally disappointing is the halfhearted effort the administration is making with the

Polaris system. We should provide funds now for an immediate start on a minimum of 15 Polaris submarines and work as rapidly as possible toward a goal of 300." Other defenses, according to Gen. LeMay, are:

- **North American B-18.** Gen. LeMay has indicated that \$42.2 million more is needed primarily to adapt boosters to USAF's high-altitude records schedule.
- **Chemical bomber program.** Gen. LeMay has asked an additional \$41 million to expedite the program.

With the acceleration of numerous programs, Defense Department has revised its estimates of expenditures. Spending for fiscal 1959 is now estimated at \$195.5 billion, instead of \$99 billion, and for fiscal 1958 at \$40.1 billion, instead of \$59.6 billion.

The \$1.45 billion request to Congress for fiscal 1959, USAF, \$777 million; Navy, \$453 million; Army, \$246 million, and Advanced Research Project Agency, \$180 million, to support anti-missile attack, satellite and other programs.

Super Bomarc Could Triple Current Speed

New York—Speeds triple those achieved by current production target engines of the Boeing Bomarc are attainable for the Super Bomarc without loss of the jet, according to a study which will involve the entire atmosphere, Roy E. Marquardt, president of the Marquardt Aircraft Co., told the New York Society of Security Analysts last week.

Improved engines developed on the program for the 400th target and bomber Super Bomarc have been two times as Lockheed's X-7 target test vehicle at Mach 4, and at altitudes higher than 100,000 ft. Marquardt said for the current Bomarc is Mach 2.5.

Marquardt's annual report, distributed at the meeting, depicted the evolution of Marquardt's engine for the Bomarc and future aircraft beginning with the RJ41-MA1 tested in the X-7A. From this evolved the RJ41-MA1 for the X-70A Bomarc, the RJ41-MA2 originally intended for Lockheed's Q-5 drone and the RJ41-MA-7 for test in the X-7A-3 and also in the X-1M-900 Super Bomarc.

She shown in development are the RJ77 engine with no jet vehicle or application specified, and the RJ95 engine for test in the X-7A-2 and a project indicated but not traced.

All three engines were based under a general heading of supersonic. An undesignated supersonic engine was listed in its evidence since 1955. The chart indicated both the Super Bomarc and the engine project engine would be in evidence before 1960.

Marquardt, which is part completing a research facility at Van Nuys, Calif., for testing small engines and components at speeds up to Mach 12, also visualizes use of targets in space.

Bomarc might be used to boost targets to high altitudes for launching the establishment of space stations, at a great saving in missile weight. Marquardt and adding such stations, in turn, it believes, will eventually be used in launching platforms for true interplanetary vehicles—powered 1 m.m. by, other Marquardt engines are already studying.

The company, with its own funds, also has been studying the construction target for a 601.

Bomarc has capabilities for very high altitudes if speeds are high enough. Marquardt believes at 6,000 mph, he said, compression ratio of a target is on the order of 1.800 to 1. Thus a target could operate at these speeds as effectively as at sea level in an atmosphere one thousandth as dense as sea level.

Marquardt has contracts for at it is included in several recent target projects including:

- **Nuclear target.** Marquardt's son, Aaron, director is associated with the University of California Radiation Laboratory and North American Atomic International in Project Pluto to develop the region Marquardt and that this project can be a relatively small company effort.

- **Missile target bomber.** Marquardt and current thinking on the vehicle is on the Mark 46 target stage. Such a project AFW-Mach 31, p. 150 could certainly lead to constant current targets.

Marquardt said in this connection he declared his interest in the French Lockheed type of piggy back launching system is an efficient and economical method for bringing targets to operating speeds. Marquardt and LeMay's services on obtaining support from the French government had personal program on an agreement.

- **High energy tank.** Again LeMay, particularly attractive in concept, Marquardt said, because the problem of deposits on moving engine parts not in harbors at about 1000 miles. Chevrolet Corp., associated with Marquardt in the Chevrolet combination, reports its latest fuel program is on its advance, but expects significant developments by the end of the year.

Sales of \$10,000,000 and earnings of \$1.62 a share on profits of \$901,000 for 1957 were reported by Marquardt. Progressive improvements in earnings through 1958 were forecast in the company's outlook for the year. The company expects to find past contracts that year, these sales will not appear in company earnings until next year, however. One plus situation now make up 91% of the company's sales.



X-15 Space Suit, Seat Tested

Effort at high speed wind tunnel at X-15 research phase engine seat and pilot pressure seat in water evaluation of USAF Flight Test Center experimental test tank at Edwards AFB, Calif. Dressed in suit in prepared for test (top photo). Seat even ribbons designed to keep seat from burning after ejection. Seat also features cloth wire pilot (bottom photo) which intercepts wires, reducing pressure on pilot by one third. Seat, powered by solid propellant rocket, starts can (bottom).



Supplemental Requests for Fiscal 1959

Washington—Following is a partial breakdown of the administration's requests for supplemental fiscal 1959 funds:

	(\$00 million)	Request Estimate	Increase	New Estimate
OFFICE OF THE SECRETARY OF DEFENSE				
Advanced Research Projects, Research and Development	514,000	510,000	375,000	
Procurement of Equipment and Materials	471,000	27,700	446,700	
NAVY	1,405,000	210,100	1,621,300	
Attack and Related Procurement	2,099,095	25,000	2,094,995	
Attack and Facilities	540,540	3,460	544,000	
Research and Development	644,000	309,040	750,885	
AIR FORCE				
Attack and Missile Procurement	1,283,300	513,100	6,497,200	
Attack and Missile Support	2,146,300	49,700	2,193,700	
Research and Development	729,000	9,600	729,000	



RUSS section reveals installation of engine and rotor hub in Sikorsky experimental ship. Helicopter in background is S-51.



T58 TURBINE engine has firing test installed before placement on S-62 prototype. Opening at top right is for rotor hub.



TAIL section has been moved to upper section, side second hull under construction at left. Tail fittings have not been installed.



HELICOPTER last hull has passed outstanding tests. Design is said to give improved water characteristics.

S-62 Nears Completion; Second Hull Under Way

Production of S-62 helicopter with first hull is proceeding rapidly at Sikorsky Aircraft Division of United Aircraft Corp., and the May schedule for first flight is expected to be met, according to General Electric T58 gas turbine engine and main parts from Sikorsky S-51 (AW Dec. 30, p. 23). Sea-going hull under Fiberglas fittings at one end bottom of tail section and no forward section of hull exposed. Engineers are considering construction of entire Fiberglas hull for future model. Electrical equipment and flight control linkage is located in spread compartments in main cabin forward bulkhead, for easy access and maintenance. Major production change from original drawings was approximating tail stabilizer to top of section. Area previous position on tail section and fuselage top. Aircraft, designed for commercial use, will have full power available up to 17,000 ft.



DOORWAY CORNER CREW, JOINTING COMPONENTS.

Moon Shot Vehicles Near Assembly

Washington—Test vehicles for the Air Force Belluette-McNair Division moon shot program authorized by the Advanced Research Projects Agency are nearing the assembly stage.

Early steps are planned for the Douglas Thor first stage, and for the second stage which uses an Aerojet-General second-stage engine from the Vanguard. The moon probe vehicle's first stage which still must be developed is to be used later when the complete vehicle is tested.

The moon probe belongs to a series of eight the number of major projects in progress or just beginning at BMD. These are Atlas, Titan Thor, WS-17L, Paul Ryan, Minuteman, and an off-the-atmosphere explosion. Their nuclear warhead for Operation Redback, moon probes and the propulsion unit of the moon space project designed to arrive at Mars from orbit in 1975 (see page 26).

Recent management reorganization of the Administration's moon shot program, ARPA's first move to bypass the Pentagon and cut out top brass, was not completely done last week.

ARPA and its authority to deal directly with Air Force and Navy development agencies and inspired them the task of implementing the moon probes (AW March 31, p. 17). The move concentrated the service reactions, military staffs and research and development commands to achieve what ARPA officials term "close management."

One of the initial steps of this close management has been announced. USAF's Belluette-McNair Division and the Army Belluette-McNair Agency will submit their moon probe proposals to ARPA as directed. ARPA will then review and modify them as considered necessary. Otherwise, the degree of free flow to be provided the commanders of BMD and ARMA is uncertain.

While this method of administering a development program with a precedent in the Pentagon, it is not the only method ARPA is considering as how to authorize its projects. A spokesman listed three methods ARPA could use.

- Award a contract directly to a private firm and then assign the administration of the contract to one of the services.
- Authorize a development command of one of the services to proceed with a specified project as was done with the moon probe program.

- Assign work through the service structure, as was done with the sub-orbital vehicle program, ARPA's other responsibility, to date.

In the direct line of command from ARPA, in this service directed program, agencies on the moon probe project,

collaboration copies of communications were sent to the service command. To make certain that ARPA development would not interfere with Belluette-McNair projects already in progress at BMD and ARMA, coordination is maintained with William Eshelby, Defense Department director of guided missiles.

Actual tasks that have been assigned are three moon probes for BMD and possibly two probes for the Army. The Army also will launch two or three additional earth satellites.

The probes are intended to explore space near the moon and test both members on the moon's surface. Planned is a "modularized ground sensing device" that will be developed by the Naval Ordnance Test Station, at Inglewood, Calif. Under present plans, the probe's remaining thrust will remain in the moon shot as a separate TV picture. Some of the equipment is directed by use of probe vehicle.

F-100D With Pilot Makes Zero-Launch

Los Angeles—Using a solid propellant rocket launcher, a North American Aviation F-100D recently made a successful zero-launch at Edwards AFB, Los Angeles was a pilot's aircraft with North American engineering test pilot A. W. Blackburn at the controls.

Launch was effected with the airplane

having its gear flaps and wheels extended as well as the leading edge flap.

No external stores were carried. Gross weight at launch was about 33,000 lb. Angle of launch was 20 deg., a critical parameter. Early experience in launch, "zero launch," shows that launch angle approximated the F-100D in use, and zero distribution and center of gravity showed that launch at any degree less than an angle resulted in damage by forcing a loop.

The launch took off with full engine power and afterburner, operating together with a booster bundle to apply a thrust vector which not only achieves sufficient speed but also attitude at steady rate.

Speculation at the Edwards launching included a group of NAAG officials. A significant use of zero launches would be in European areas when a number of tactical aircraft are deployed.

Adding to the tactical significance of the zero launch system, is the fact that F-100D aircraft already in field operation since with Air Force, such as shown for that aircraft, need no basic structural modification to accept zero launch capabilities.

While the F-100D is the only current Century-series airplane that has zero-launch capability, a North American Aviation F-100D recently made a successful zero-launch at Edwards AFB, Los Angeles was a pilot's aircraft with North American engineering test pilot A. W. Blackburn at the controls.

F-104A is considerably lighter than the F-100D, would require no major structural redesign to accept zero launch capability.



Army Drone Constructed of Plastic

Zenobough launched, recoverable Army SD2 all-weather surveillance drone's first design and full components of bonded plastic construction for use of operations. Army Drone was designed and developed by Kollsman Manufacturing Co., Denver, Colo.

General Dynamics Sales at \$1,500,000,000

New York—General Dynamics Corp. set sales in 1977 reached a record high and passed the billion dollar mark for the second consecutive year.

Net sales totaled \$1,502,331,000 compared with \$1,021,261,349 in 1976. Net earnings, also a record, were \$14,775,785 compared with \$15,051,092 in 1976 or \$4.04 a share compared with \$4.01 a share earlier.

The corporation includes the Convair and Convair divisions as well as aviation segments. Other financial reports:

- **Fairchild Engine and Airplane Corp.** Earnings declined sharply in 1977 largely because of the dropping off of \$8,710,577 of aircraft earnings, as to revenues of the F-37 turbojet transport program. Earnings were \$181,511 on sales of \$18,621,612 or 17 cents a share compared with earnings of \$1,551,484 on sales of \$15,575,751, equal to 64 cents a share for 1976.

- Had it not been for the F-37 investment, profits would have ended with the last year as the company's losses, the report said. "The same program will produce a sizable loss for the first part of 1978, the report said, but the rest of the year should show a profit. The first 3-17 is scheduled to fly this month.

- **Loe, Inc.** Sales of \$54,082,575 in 1977 topped the 1976 total of \$65,900,000, a previous record for the company. Net income declined because of government restrictions on electronics items \$1,786,018 or 65 cents a share in 1976 to \$10,821 or 36 cents a share.

- **Curtis-Wright Corp.** Diversification into consumer fields helped hold sales and earnings at high levels. Sales in 1977 totaled \$98,871,622, with earnings of \$19,073,582. The 1976 total was \$77,064,701 for sales and \$47,151,053 for earnings.

- **Kaiser Aluminum Co.** First quarter 1978 earnings showed a 72% increase over the same period last year—\$10,144 compared with \$5,866,616. Sales for the first period totaled \$1,191,019 compared with \$1,223,114 for the period a year ago, indicating an improvement in the ratio of profit to sales.

Army Developing Long-Range Drones

Washington—Army is developing long-range, long-endurance reconnaissance drones equipped with radio, infrared, television and/or camera for combat surveillance. Lt. Gen. Arthur G. Trudeau, now chief of Army research and development told the Armed Forces Communications and Electronics Act last week.

Lycoming Engine Built For Business Planes

Latest development in the Lycoming engine line is a variable duct three-cylinder developing 190 hp. Intended for business aircraft applications, the first six-cylinder to be powered by the new engine will be an improved version of the Pietenzo Conquest.

Engine designated Model C146-ASA weighs 565 lb., giving it a hp/hp rate of 61 to 1. Fuel is estimated 91/96 octane.

Standard engine accessories include 12 volt Delco-Remy starter, generator, oil-pressure regulator, Mott-Schleicher M-105 carburetor and Bendix S&L318 (right) and S&L321 (left) magnetos. Propeller governor drive, fuel pump drive, vacuum pump drive, and hydraulic pump drive are offered as optional equipment as well as 12-volt 35 and 30 ampere generators, and 24-volt starter and generator. Engine has CMA certificate No. 291.

Gen. Trudeau, a civil engineer and graduate of West Point, takes over the post formerly held by Lt. Gen. James G. Cass, whose resignation became effective last week.

Army will need 12 acquisition aids and other methods for controlling the "chaos" of Army assets which we will use," Gen. Trudeau told the AFCEA. In the field of reconnaissance, Gen. Trudeau said the Army "cannot properly equip anyone with images of terrain of order without a reconnaissance increase in our target acquisition capability—one of the greatest challenges we face today."

The new draft of research and development called for increased use of computerized and automatic data processing in logistics and administration, as in defense and communication systems. Army also needs better training facilities for its aircraft and missiles, he added.

Atlantic City Chosen As AMB Test Center

Washington—Atlantic City, N. J., Naval Air Station has been selected by the Army Materiel Command as site for its new National Aviation Facilities Experimentation Center that will be used to evaluate new traffic control system and techniques.

Concepts and operation of the new center could begin as early as July of this year if negotiations are speedily concluded with Atlantic City officials for use of the required land, according to AMB Chairman Edward Quenda. Selected by Atlantic City from nearly 1,200 possible sites considered

was based on a number of factors, including:

- Both line airports to the east and westly direct military traffic to the west will enable facility to conduct experiments both into the coast, and evaluate system and techniques later under operational conditions.

- Established facilities and plant, which will be needed by Army, minimize the new investment required and will enable AMB to put new facilities into operation quickly.

- Variety of weather conditions, including a number of aircraft days, provides for type of environment needed for AMB tests.

- Proximity to first SAGE or defense system installation will enable installation of new traffic control system components with SAGE system.

- Availability of certified aircraft operations for participation in AMB system tests.

Atlantic City will continue to be used for commercial airline operations. Quenda said. Facility is expected to employ approximately 225 technical and professional AMB personnel during 1978 and will have a \$12 million budget for its first year operations.

News Digest

Vertol Aircraft Corp. rolled out its Model 107 tandem rotor helicopter developed with company funds and began ground tests at Philadelphia International Airport. Helicopter, powered by two Lycoming T53 turbine engines, will fly this month (AVF Feb. 17, p. 21).

Argentine Airlines is buying Conquest IVs to replace DC-7s on six routes between Argentina, London and New York. Manufacturer de Havilland last week had not confirmed final settlement of the contract, but it is understood at least one of the two-engine jets are involved in a \$12 million price. Delivery is expected this year.

Republic Airlines Corp. employees last week called a strike for midnight Wednesday but returned to work, next morning without setting up picket lines at Farmingdale, N. Y., an union of International Union of Marine, Shipbuilding, Shipyard and Aircraft Workers employees. Union and management last week were locked in a six-day contract dispute in attempt to meet the softest Major issue is wage. Union wants an increase from 36 to 42 cents an hour. Company offers a 10 to 12 cents. Union and 1,000 non-union voted to strike, 900 deserted.

Chrysler Corp. has received a \$25,767,291 Army contract for expert parts and components for training.

EEMCO ANNOUNCES

... a new electro-mechanical actuator
to drive airborne cargo bin
conveyor systems



EEMCO electro-mechanical actuator (Type D-901) has been developed for use on airplanes to drive their baggage bin conveyor systems. Operated either electrically or manually, the actuator moves the bins forward or aft, and holds the bins in any desired position.

This new EEMCO rotary actuator consists of an intermittent duty 200 volt, 3-phase, 400 cycle AC motor and gear box. It is electrically reversible and includes an AC operated brake, thermal overload protection, manual drive input shaft, and reverse torque lock mechanism.

The unit is designed for normal operating load of 810 lb. lbs., torque at 16 rpm, 1.4 amps, and meets all pertinent military specifications. The maximum static load without permanent deformation is 3100 lb. lbs.

EEMCO specializes in the design and production of precision-built actuators and motors. The majority of the latest and fastest aircraft and missiles carry out or more EEMCO systems. Prime contractors of civil and military aircraft rely on EEMCO's years of experience in the accurate design and production of motors, linear and rotary actuators.

SPECIFICATIONS FOR TYPE D-901

Motor: 200 volt, 3-phase, 400 cycle AC motor with gear box.
Normal operating load: 810 lb. lbs., torque at 16 rpm, 1.4 amps.
Maximum static load: 3100 lb. lbs.

Weight: 62 pounds.
Excitation: Type D-901 has been designed and qualified to meet applicable military and commercial manufacturers' specifications.

For inquiry is invited.

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Financial Crisis Hits All-Cargo Airlines

By Glenn Gerson

Flying Tiger, lastest of the three still flying common carrier freight hauls, "got us back to the wall," according to President Robert Prescott. But if the business decline continues and other sources of revenues slacken off, "we'll be in trouble," he said. Negotiating other sources, the holding firm said.

operating loss of \$1,608,730. Revenues from other operations such as military contracts and North Atlantic passenger charters totaled \$12,570,024, with a profit of \$1,086,976.

Despite an intensive root reduction program last year, Black men, dying at an ostac business left no money to support the common (average) open bid. And, with the business recession,

AAXICO joined in 1956 and began operations only three of its on a north-south pipeline expanded the capacity to 40 C-46s in more than 20 years. Several of its Lagan wells are leased in class

Confusion exists over the role of the International Chamber of Commerce in the development of the rules. The ICC has been active in various proceedings involving the cargo claims' center. In the Freight Revenue Case, decided in 1981, the ICC's position was that the re-

"As a matter of fact, it looks as though in the past 18 months the [oil-cargo] industry has finally started to achieve the solidity that we had hoped for. I do not want to leave the impression that the fiscal regime there causes us trouble at all."

Douglas Lathrop is making extensive use of twin engines, four-blade Cessna Aero-8's and single-engine Bessons. As is usual in East Germany, the summer vacation flights Russians designed 26 new D-14 transports are being built at a Dresden factory.

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MST 2.5Al-16V... the first readily formable, heat treatable sheet alloy

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would be soft and formable in the annealed condition, and which could be heat treated, after forming, to high strengths while retaining ductility. With this material, yield strength can be as low as 50,000 psi, to permit easy fabrication, then increased to 130,000 psi by heat treatment. Age hardened sheet has good

short-time hot strength—about 100,000 psi yield strength up to 600°F. These alloys, now in limited commercial production, are further development of rapid advances in titanium. Use Mallory-Sharon's outstanding technical experience and service on your present requirements—or future plans—in titanium.

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Miami Expands to Meet Traffic Increase

By L. L. Doty

Washington-Miami International Airport last week accelerated its terminal expansion program to permit for a traffic increase this year that is expected to boost the airport into the nation's top-ranking business field.

As a result of the recent Civil Aeronautics Board decision on the Great Lakes-Northeast Service Case (AWB March 31, p. 10), three major airlines will make their appearance on the Florida scene for the first time. The Board last week announced the details of the new route which is expected to be in effect by the year.

The new route would bring the number of U.S. domestic carriers serving Miami from four to seven and increase the total of all airlines operating schedules into the airport to 37.

During fiscal 1957, Miami International Airport handled 150,000 aircraft movements to and from the Chicago-Miami Airport which had 575,000 aircraft movements.

Los Angeles was in third position with a total of 290,000 aircraft movements during the year.

The new service will increase the number of airlines serving Miami to at least 10, with an increase of 40,000 per month. Each of the four airlines involved—Capital, Delta, Northwest and Trans World—will maintain that sufficient traffic is available to fill those seats at a reasonably high load factor.

Airline Plans

However, Capital, which was granted the right to fly between Buffalo-Cleveland-Pittsburgh and Florida, was instructed from operating an airplane service from either on its return east of Cleveland. In its schedule in the new route, Capital would not only have to fly its traffic pattern would be drawn from either at or east of Cleveland.

The airline feels that the reduction of its traffic pattern would be a disadvantage. It is expected that the new route will be a through-plane service to Florida.

Trans World Airlines, which was granted a route from St. Louis to Florida, is expected to begin the new route with six flights a day to Miami using Lockheed Constellation and Martin 404.

Emphasis will be placed on coach service in the schedule.

Northwest will operate DC-7C flights for first-class service and DC-6B for coach service with the new flights scheduled to begin about the middle of September. Delta probably will operate its new route between Detroit and Miami on a service pattern similar to that serving the Chicago-Miami route.

Capital apparently is protected equipment-wise as the result of a position in its agreement with General Dynamics Corp. concerning the purchase of new Convair 440 jet transports (AWB Feb. 3, p. 40).

The agreement states that General Dynamics will lease to Capital from a third party "up to 10" new Convair 440 jet transports at an annual rate of \$1.5 million. Since the previous was contingent upon the outcome of the Florida case, Capital presumably will use the leased aircraft to serve its Buffalo-Miami route.

Competition for Eastern

With the exception of the frequent between Buffalo and Pittsburgh, on Capital's routes, all the new services will provide additional direct competition to Eastern Airlines. Of the four new carriers entering the Florida route, only Capital carries an airline schedule in Florida as the result of its seven-year-old interchange agreement with National Airlines.

Northwest Airlines, which was a New York-Florida route in late 1955, has now also withdrawn, as attempting to enter a large share of the market. In maintaining its 1957 \$4.1 million net loss, the airline admitted that "as the concept of the carriers in the Eastern Convair-Florida market, we are at the present disadvantage."

Both Eastern and National are strongly entrenched in the Florida area and the new route would provide better competitive battle for traffic, particularly in the Florida market division next year as it did this season.

Miami Well Equipped

The Miami airport is well equipped to handle the additional traffic flow from its air traffic control standpoint. Arrangement of low runway permit dual landings and takeoffs under the conditions. Instrument approaches lead in the Miami to north traffic control center totaled 4,351 during fiscal 1957 as compared with 3,400 in the New York area, 97,000 at Los Angeles and 51,000 at Chicago as air traffic control center.

As a result, weather conditions do not seriously bog traffic to a substantial as in the case of other airports. Expanding ground facilities cause some delay in February and March, however.

Terminal facilities are not generally adequate to accommodate the new volume and, last week, representatives of Northwest and Capital went to Miami to discuss temporary measures to handle

ticket counters and office space and gate facilities.

A new terminal now under construction will be available for occupancy by December, but that all airlines serving Miami will have sufficient ticket counter and waiting room areas.

As a result of the recent route awards, the addition of a sixth terminal building will be required to provide adequate gate space.

Under original plans, four flights were programmed. A fifth was added when Northwest began service last year, a sixth a new found readiness to handle the needs of Capital, Northwest and TWA.

The cost of the additional construction work is covered by the bond issue recently floated for the new terminal.

Route Details

Here are the details of the new routes designated by the Civil Aeronautics Board:

• **Northwest Airlines**—Chicago to Miami via Atlanta and Tampa-St. Petersburg-Clearwater with stopover privileges between any of the northeast cities and Chicago. Northwest can provide single-plane service between these points via Chicago and may also use its Northwest's routes.

• **Delta Air Lines**—Delta's route between Miami and Cincinnati was extended to include a stopover at Tampa-St. Petersburg. Delta's present Florida Detroit service.

• **Trans World Airlines**—TWA was permitted to serve Nashville, Atlanta and Tampa between the terminal cities of St. Louis and Miami. Single-plane service is permitted from Florida to south end of St. Louis.

• **Capital Airlines**—Capital's new route permits service from Miami to Buffalo via West Palm Beach, Tampa, Jacksonville, Pittsburgh, Youngstown, Akron, Cleveland and Erie. Capital is restricted from providing an single-plane service out of Cleveland. It cannot provide "local service" between Buffalo and Cleveland.

The airline is prohibited from providing single-plane service between other points in the area north of Atlanta on its route to Washington. On flights between Buffalo and Youngstown and between Youngstown and Erie, passengers may originate and terminate at these points, but the flight themselves must originate or terminate at least in the south at Atlanta.

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Mil Plans Mi-1, Mi-4 Helicopter Changes

Moscow-Krasn's leading helicopter design Mi-1. Mi-4 is considering technical modifications in its engine system. Mi-1 and Mi-4 to make them more suitable for passenger transportation.

Biggest change may be replacement of the present piston engine with gas turbine.

Mil estimates that substitution of a suitable gas turbine engine for the Mi-1's 370-hp, 40-50V piston engine would reduce the helicopter's weight by at least 100 lb. and increase its payload considerably. Mil says "the gas turbine engine, being installed in one, could be installed over the passenger cabin, thus cutting in its engine weight. The same engine which could then serve as a main passenger seat."

The same principle applies to the Mi-4. Using rotor, transmission and other parts now in production, but replacing the present 1,100-hp, 40V-50V piston engine with a gas turbine, Mil says, the Mi-4 could accommodate 15 passengers.

Another advantage of gas turbine, according to Mil, would be lower maintenance. He points out that the two-blade engine on the Mi-1 is considerably lighter than the single piston engine on the Mi-4.

Mil frankly admits that the Soviet air force Aeroflot is not enthusiastic about using helicopters for passenger and mail transportation or for agricultural and forest protection purposes because they are considered too expensive. Aeroflot contends that the initial cost of the craft would grow while overhaul and depreciation periods are comparatively short.

Overhaul Time Doubled
This is the case despite Russian claims that time between overhauls on the Mi-1 and Mi-4 has been doubled since they first appeared in quantity in 1959 and 1972 respectively. Mil, who is the USSR's number one helicopter salesman and promoter as well as designer, says there is no reason why the period between overhauls on the Mi-1's engine cannot be further lengthened and so on.

Depreciation costs can also be lowered as in the case of operating expenses. Experience in this far north shows it is not profitable to operate the Mi-1's helicopter to 100 lb. in the north.

Original cost of the helicopter could be cut in half if production was increased—thereby lowering further the cost per flying hour.

Mil already has decided plans for getting maximum utilization from the Mi-1's by using it as agricultural and forest work during the spring and fall and for carrying passengers and mail during the summer and winter.

In its agricultural version, the Mi-1's carries up to 100 lb. of chemicals. Mil says that for forest work and for carrying passengers, mail and cargo the Mi-1's is more economical than an airplane.

An agricultural version of the Mi-4 also has been tested "with encouraging results."

Form Use
Mil points out that Aeroflot air planes involved in agriculture and forest work often require the protection of longways in field, upon which much money is spent. At the same time, the effectiveness of working on climbing down a helicopter is greater than from an airplane.

However, despite these advantages within the USSR Ministry of Agriculture, the Aeroflot State Scientific Research Institute, there are technical difficulties in using helicopters for such numerous types of work.

Mil also thinks Aeroflot should show more enthusiasm over using helicopters for short-haul mail routes.

The Mi-1 is not perfect, he claims, can be used to 100 lb. and the craft's gross weight increased to 5,200 lb. which obscures the potentialized benefits.

It is true that for some over land routes the Mi-1's range is hopelessly insufficient. Otherwise, the length of provincial aerial hops is up to 800 kilometers (775 mi). Long flying ranges are particularly common in the far north.

Improving the helicopter's range would undoubtedly increase Aeroflot's interest in the craft. Therefore, an aircraft that has been designed for mail delivery on the Mi-1's which per year is loading the cargo in 170 kilometers (106 mi).

During the growing use of helicopters for urban passenger transportation in the U.S. and on Europe's Paris-Bordeaux-Marseille line, Mil said that Soviet urban flying craft should be employed under similar circumstances as well as in areas without adequate roads and airports.

The Mi-1 is already being used successfully for carrying passengers in mountainous and coastal areas. This model machine has a cabin roomy enough for eight persons, a lavatory, wash and baggage compartment.

The design bureau has worked out plans for a 10-place version of the Mi-1P which has a range of up to 400 kilometers (249 mi).

Wide-scale utilization of this model would, however, enable Aeroflot to reduce its helicopter operating expenditures.



Soviet Coaxial Rotor Helicopter Seats Four

Soviet Krasn's 15 latest helicopters (SW Aug. 11, 1975, p. 31) called the Flying Cub are now in use over Krasn's air bases. Fuel tank capacity sufficient for a 4 to 6 hr. 30 min. flight. Coastal route from Makh. Helicopters has a 150 hp. preheated and a cruising speed of 75 mph. Vehicle may be used over rough terrain, as general use.

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SHORTLINES

►British Overseas Airways Corp. to give a 30% increase in bookings for summer transatlantic flights over the same period of last year. BOAC attributes the increase to new economy class fares effective April 3 with only 65% of the total on this category. BOAC is scheduling 32 weekly flights from New York to England and for the first time, daily service from Boston to Britain.

►Civil Aeronautics Board has approved a United Air Lines proposal for coach fares over five routes which would be less than \$2,500 higher than regular coach fares. Routes involved were Chicago-Cleveland, Chicago-Detroit, Detroit-Philadelphia, New York-Boston and Portland-Salt Lake.

►Taipei, China, S. A. Amherst (Agent) has been recommended by a Civil Aeronautics Board committee for a design as carrier partner between Boston Area and Mexico. The plan applied for scheduled service from Boston Area to Santiago and Antofagasta, Chile, Lima, Peru, Guayaquil, Ecuador, Panama City and Miami. The company proposes to add tourist service using Douglas DC-4 aircraft operating on a twice weekly basis. One-way fare would be \$335 and round trip \$475.

►KLM Royal Dutch Airlines plans to double its flight capacity next fall with three Lockheed L-1049H Constellation. The airline's current expanded transatlantic capacity is just less than 180-190. In two months, introduction of the new equipment will allow doubling the capacity to nearly one million in early month.

►North Central Airlines reports gross revenues of \$18,931,995 for 1971, 51% above 1966. North Central President H. N. Cox credited the increase to substantial increases in all classes of traffic. Net earnings, after tax credits, were \$80,791 as compared with \$74,176 in 1970.

►Northwest Airlines' Board of Directors has declared a dividend of 30 cents a share on common stock and a regular quarterly dividend of 75 cents a share on 4.62% cumulative preferred stock payable May 1 to stockholders of record at close of business on April 15.

►South Alaska Airlines has ordered three Boeing 707 aircraft for use in GAA's service between London and Johannesburg, S. A. The airline expects delivery to begin in July, 1969.

AIRLINE OBSERVER

►Soviet Union's attempt to sell Russian jet transports to Soviet Airlines Co. and Egypt's airline, Mena, has been shelved. The two carriers, which will be ordered according to plans of the new United Arab Republic, are interested in the Gostele, Concorde 4, Vickers Vanguard and the Lockheed Electra. They have considered the Russian transports but are finding it impossible to get performance figures on which they can evaluate competing costs. When the contract is for delivery on the service life of competitors, the Russians cannot be persuading to give the companies all the specs they need. On the subject of parts support, the Russians boast that all with assurances that parts requiring repair will be replaced by new parts.

►Although air travel outlooks are expected to accompany the introduction of jet transports, one major concern before that all long-range air services who expect a decline to return will be achieved within one year at the beginning of full-scale jet operations. According to the airline's perspective, new lines will begin within two years. The forecast assumes that traffic will continue to increase according to historic patterns.

►Civil Aeronautics Board has denied a request by the Air Transport Association to change the effective date of a regulation requiring the installation of flight recorders on large aircraft certified to fly above 15,000 ft. from July 15, 1968 to Oct. 1, 1969. ATA charged that existing tests proved present flight recorders to be unsafe for use on aircraft and others certified. CAB claims that "critical timing" of the introduction of jet detectors that flight safety will not prove any delay in the use of one available tool.

►American Airlines will be the first to operate coast-to-coast jet transport flights "with service between the East and West Coast to begin before the year is out," according to American President C. W. Smith. Smith also said in the company's annual report that a "limited number" of Electra will begin service before the end of the year. The airline has 35 Electra and 18 Boeing 707s on order.

►Chicago Helicopter Airways has set a sales target of 110,678 passengers for 1971, with a goal, month of 15,770 passengers established by October. The airline carried 95,114 passengers in 1970. Meanwhile, Civil Aeronautics Board has declined a resolution over an agreement between the airline and United Airlines for the exchange of three Embraer EMB-355 jet engines for two 350s owned by United. The exchange is expected to improve Chicago's operating efficiency and provide the desired capacity.

►McDonnell Douglas has ordered two DC-9s, for replacement of retired DC-3 equipment by its existing local service airline. McDonnell's first new consists of 11 Canadair 240s, one DC-9.

►Long-range capabilities of Boeing's new 747-100 transport plane were demonstrated last month when the 79-passenger plane flew the 2,536 mi. detour from Miami, Fla. to London in 14 hr., 45 min. average speed exceeded 571 mph, cruising altitude was 38,250 ft. The trans-Atlantic flight marked the completion of the 8-8-8's latest tests.

►Misrouting of passengers has resulted in the introduction of two bills in the House designed to protect passengers against overbooked and delayed flights. One bill would permit overbooked passengers to bring action against an airline or any U.S. district court for money damages in excess of \$500, plus twice the amount of the fare paid on \$500, whichever is greater, and reasonable attorney and court costs. Other bill would establish a penalty for passengers, whose flights have been delayed or cancelled, on other flights of the same carrier to the same destination.

►Civil Aeronautics Board last week approved the new International Air Transport Association law on North Atlantic routes. The new rules, to become effective before Dec. 31, require instant final class and tourist rates 10% but provide a "deadweight" amount free that is \$65 less than standard tourist fare. Earlier the Board approved the dual-class "economy" fare on North Atlantic routes (AW Mar 24, p. 31).



Republic Stainless Steel Circles the World

When "Explorer I" was successfully placed in orbit by the U.S. Army from Cape Canaveral on January 31, a new era was opened for the use of Republic INDOX® Stainless Steel.

Vital instruments in the nose section of the satellite are protected by a cone of stainless steel produced by Republic. This cone was fabricated from Type 430 by The Lodge and Shipley Company, Cincinnati, Ohio, using the Hoture Process. By flow-forming, the wall thickness of the cone can be increased in specific areas to comply with design requirements of high temperatures or stresses.

Stainless Steel is highly ductile. It is readily formed into desired shapes by cold-forming, drawing, and bending operations. It provides low thermal expansion and is highly resistant to atmospheric corrosion, erosion, and oxidation at high temperatures.

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Official U.S. Army photograph shows launching of Explorer-C Missile and "Explorer I" Satellite from Cape Canaveral, Florida, 12-41 PM, 1957, January 31, 1958.



"Explorer I" is protected on one end by a cone of stainless steel. The satellite is ground-lifted as much as one meter as it is lifted. Reduced copy of one-foot 780 photo was started on the ground before the satellite was launched. In this Official U.S. Army photograph, the cone of stainless steel at the top of the Explorer I is the cone of stainless steel fabricated from Republic INDOX® (Stainless Steel), Type 430.

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HEAVILY shielded plasma jet with pulsed effect is studied in General Research Laboratory (left). Continuously operated plasma generator (right) also being studied is used in propulsion studies at Glenn. Specific impulses as high as 600 sec. were recorded.

USAF Directorate Backs Space Study

By Irving Stone

Forrest, Calif.—Basic research leading to developments in space technology is being conducted by Directorate of Advanced Studies, Air Force Office of Scientific Research.

This approach, emphasized by Directorate of Advanced Studies early in its existence, is the key effort in its overall mission to sponsor studies in broad areas indicating potentials leading to development of practical applications in future Air Force operational categories.

Research the directorate is supporting relates to those areas:

- Space environment exploration
- Space vehicle development
- High accuracy navigation

Despite successful test of atmosphere

soundings over the past few years, problem of progressing further into space and extending observations or physical equipment still presents formidable barrier which must be topped to pave the way for Air Force operations in this new environment. Scientists and engineers concerned with space technology all agree that it will not be possible to blast into this environment without extreme precautions. This makes preliminary space exploration a top priority focus. Some key data gathering concepts the directorate is sponsoring are proceeding through evaluation, include:

- Number, size and velocity of meteoroids and effect of impact on structures likely to be used in space exploration
- Intensity of magnetic fields in space regions expected to be operational

areas in the relatively near future:

- Electric distribution in space, a condition which will affect radio communication in both manned and unmanned vehicles
- Cosmic ray intensity in regions beyond earth's cover
- Mass measurement and surface characteristics. These are considered essential for preliminary lunar exploration, leading to placing instrumentation on the moon or establishing a base there

Project Perseid

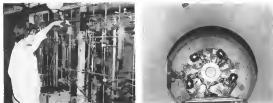
Initial practical implementation for gathering data in some of these research areas is Project Perseid which has been sponsored by the directorate and coordinated under contract by Ames Research Service, Inc.

Perseid Phase I (JAN Oct. 28, 1957, p. 31) has been a transatlantic jump into space technology regime. Vehicle employed was the best to carry instruments to extreme distances, comparable to earth's radius.

One of the key aims of Perseid was to evaluate vehicles which could be built in quantities at small expense to point the way to future economies in exploration. Cost for designing, building and launching the vehicle exceeds single Phase I was less than \$1 million.

It is indicated before the launching the vehicle at 100,000 ft., the first stage rocket vehicle instrumentation and other factors. Altitude reached—higher than with any other projective previously launched—was at least 2,500 mi.

Probably three of the vehicles carried



APPARATUS for collection and identification of free radicals photochemically produced at Ames General Corp. is at left. Kilometer rocket-MO monitor (right) is viewed from above at Ames General. Photo shows 'hot' cell and orbit position mechanism.

this height, perhaps another reached the full 4,000 mi. goal.

Two design questions, orbit data-gathering problem were solved in Perseid Phase I or solution were indicated for coming into future space probing vehicles.

- Vehicle structure and components without accelerations as high as 200G.
- Special timing circuits were devised for exact timing of project stages

Vehicle was stabilized outside the atmosphere by introducing gas at 450,000 rpm by cutting link stage rockets.

Total of each of the 10 probes required speed measurement of an instrumentation and telemetering transmitter. Magnetically and thermally were developed with 12 sec. and less, since, based to obtain long distance with minimum power, no solid and powered to avoid adverse effects of environment.

Course by counter was developed by Fred Long Steger, University of Mass.

Rockets were stock items, but were modified to get maximum performance at extreme altitudes. Total initial burning time was slightly under 8 sec., and first burning vehicle was 21,000 ft. Effects of surface burning or of one rocket being ignited before another in a drive vehicle, was prevented by directing thrust of each rocket through vehicle's center of gravity.

Ground raw data obtained pointed the way to improved data gathering approach for future up in space exploration. In Perseid I stage, course and instrumentation was very dependent on vehicle applied to the Gogot tube. As a result of environmental conditions, the vehicle drifted beyond limits in its test, rendering data interpretation difficult.

Magnetic field measurements were intended to aid astronautics development in connection with future research projects in the vicinity of the moon, but also aided in determining attack of Perseid vehicle.

Magnetic Variations

Measurements indicated that the magnetic field varies in accordance with theoretical predictions, that there are anomalies in the magnetic field, due to electron currents, which also were expected to be found.

Directorate of Advanced Studies is preparing studies the development of techniques for measuring magnetic disturbances. It is planning to sponsor work which would simulate more data particles in the laboratory and determine their effects on research. Negotiations are under way with contractors to conduct these experiments.

Meteorite measurement techniques expected to be developed in this category would be used in future research vehicles.

Phase for each of these vehicles, Perseid II (JAN Nov. 4, p. 17) are already completed, awaiting approval by Air Research and Development Command as a follow up by Ames team, of Perseid I. The Phase II vehicle, referred to as a preliminary study under Perseid I project, is intended to place a payload in the vicinity of the moon, not necessarily for impact on the moon.

In addition to studying number, size and velocity of meteoroids beyond the fringes of earth's atmosphere and in outer space, Perseid II project would also measure the moon's magnetic field if any, with instruments developed during the Perseid Phase I project. Also prepared for mission



COMPOSITE photo shows Dr. Morton Meyer (left), director of Directorate of Advanced Studies, and Lt. Col. Russell Holcomb (right), commander of 891st Air Force Support Squadron, conferring during recent Perseid Phase I firing at Edwards. Dr. Fred H. Koenig was in charge of research and development, Ames Research Service, Inc. at right.

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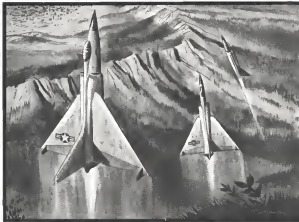
Sufficient research progress has been made so that very broad discussions regarding implementation of a reconstruction project are underway. Only basic concepts are needed—details are necessary still in a formative stage—since bulk of the effort is concerned with fundamental aspects of reconstruction process.

- investigation of techniques to produce and stabilize free radicals

Energies per pound of propellant storable in the form of free radicals will be two to five times that available from known chemical reactions that produce storable useful products.

Characteristic of these free riders is that they moonbeam almost as soon as they are forward, hence the big problem will be to stabilize them so they can be stored in a practical way for use in a rocket.

been established for very short periods. But the reward for sitting with non-constructive or energy sapping to other two that often in this area will be associated to promote new concepts for forming and stabilizing free radicals.



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charge, light gas ions, hydrogen or helium in the propelling medium, and electromagnetic devices such as inductors, coils, coupling, levelling magnetic fields acting on particles or magnets, virtually all electromagnetic repulsion devices employing magnetic fields acting on current-carrying particles or cathodes.

Studies would encompass various types of materials and various particle sizes and speeds.

• **Determination of electron and ion density in space.**

Knowledge of these factors is essential to understand the environment in which high altitude rockets and missiles and circumvented vehicles must operate.

This information may also lead to relatively simple means for ion beam detector testing and navigation.

These far experiments in detection electron density, ion and radio waves reflected from ionospheric surface, and data given, would thus directly contribute.

The proposed experiments use of a high altitude vehicle or possibly large balloon in reflecting medium for production of point-to-point information on some field in space.

• **Determination of ion, hydrogen and oxygen stream with velocity.**

Plasma beam from this work is seen in the calculation of drag and associated acceleration phenomena during flight in various upper atmosphere, perhaps 60 to 100 mi. altitude.

Two atoms impinging on a surface are interesting with it in very delicate manner than do molecules because of the possibility of near-contacts of atoms at the surface and chemical reactions of the atoms with the surface.

Study would include fundamental or penetrative model of ionizing source ions which might exist in high upper atmosphere. This proposal has been approved and forwarded for contract negotiation.

• **Measurements of ionization levels.** Purpose of research would be to determine whether such ionization exists. While considerable study has been done in the infrared and visible regions of radiant spectrum, little or nothing seems to be known about ionization in the microwave region. One study, concerning ionization of this region, is in progress, which could open interesting fields of ionization applications.

• **Plasma ion source for propulsion.** One proposal involves exposure of a heated metal having a high work function such as tungsten or platinum, in the vapor of an alkali metal such as sodium. When sodium reflects into the surface, it tends to give up an electron so that the sodium atoms is converted into a positive ion. When



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signed and which is now used in the B-52. These systems require 4 seconds of arc, and Perkin-Elmer has been able to mass produce them on a steady production schedule. Aspheric, too, are being made in quantities as a result of exclusive production techniques developed by Perkin-Elmer in the past several years.

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A PROVEN SYSTEM—Cubic MOPTAR (Multi-Object Tracking and Ranging) combines Angle Measurement Equipment (Cubic AME) and Distance Measurement Equipment (Cubic DME) which have demonstrated their operational excellence in America's major missile ranges. In a recent missile evaluation flight, for example, a single Cubic AME installation provided high precision tracking data from launch to 1000 miles downrange.

A SIMPLE SYSTEM—The fundamental advantage of both Cubic AME and Cubic DME consists of extremely accurate phase comparison. To measure range with Cubic DME, the phase of a demodulated signal which has been transmitted to an airborne vehicle and then returned back to the tracking station is compared with the phase of the signal which modulated the original transmission. In Cubic AME, the range transmitted signal is measured at several pairs of quadrantal antennas on the ground. From the phase difference observed between the antennas of two pairs whose baselines are mutually perpendicular, it is possible to determine two direction cosines of the pointing vector to the airborne vehicle. In Cubic MOPTAR these two direction cosines and range are combined to provide highly accurate and clear open-position indicator, independent sampling and coding techniques provide multiple target capability and countermeasures in cluttered air.

A VERSATILE SYSTEM—Cubic MOPTAR is completely mobile. The electronic equipment is mounted in a single air-conditionable mobile van, the fluid electronic systems for a typical installation is presently mounted on the ground but can be modified to be mounted on their flying vans which are approximately 50 feet long when fully extended. The no-lower transponder is a small, low-power unit which has been designed to operate satisfactorily in the most stringent missile environments.

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usually is known as the Langmuir technique.

Another proposal for practical use seems to be associated with diffusion of atoms through "solid" walls to produce positive ions. It involves a complicated structure, set up on two walls separated, between atoms and the wall. Consider for this experimental study already has been initiated.

Third, whereas proposed methods for determination of a vehicle's position can be generated without application of electrical power in certain electrostatic solutions under proper conditions of temperature and pressure.

Fourth, study for lightweight can not power sources in connection with use in plasma propulsion. These lightweight units, however, could be used in various power units in a vehicle which would use electrical or electrostatic propulsion systems.

High Vacuum

The department has presented in high vacuum studies high vacuum research laboratory (HARRIS) built by. Latest findings under contract for the direct basic has demonstrated the value of such a facility to carry out research associated with space conditions (NAV Dec 14, 1957, p. 62). Indications are that this facility, as a research tool, will permit itself every time in future developments.

Laboratory already has standardized studies of about 95 air with one shielded, and with various modifications may possibly simulate situations of 150-200 air.

Tests in the chamber have demonstrated feasibility of man manipulating tools and instruments under high vacuum when he is properly protected by suitable personnel as that developed as part of the overall research facility. Use of electron gas to detect very small leaks under high vacuum, can permit to space vehicle conditions, also has been demonstrated.

One of the big studies projected for the laboratory is investigation of metal surfaces. Friction phenomena under high vacuum, where lubricating surface films including adsorbed gases are drawn off, leaving the metal to react in other naturally coated. This condition may affect operation of mechanical devices in space craft. Some preliminary research in this area has already been done in the chamber in its real time under actual contact with friction.

Plans are being made to utilize the laboratory in the study of design parameters and performance of electromagnetic plasma acceleration for possible propulsion use. Chamber will often a necessary robotic environment for study of this unique possible pointing out

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differences associated with experimental ground tests and accelerated corrosion mental conditions.

Other plans involve use by other agencies of the chamber as an engineering development tool to determine, make or verify comparisons in the simulation of dependability.

Similar plan is to use the laboratory for checking performance of the "space" unit developed for flight with North American Aviation's X-15 sub-orbital aircraft. This will provide opportunity to check out, under realistic safe conditions, the most critical part of the overall X-15 system—protection for the pilot.

French Firms Start IRBM Study Group

Paris-Group of French companies, mostly aviation and chemical, have headed together under the name "Force Rockets" to study problems of building intermediate range ballistic missile weapons in France.

New group is sponsored by French Defense Ministry. View is that since no one company has the facilities to tackle IRBM construction, the problem is best handled by pooling available resources. French used the same system in building the country's first atomic reactor.

French group has sent a team to the U.S. to study IRBM development and fabrication progress. French Defense Ministry reportedly would like to have Force Rockets begin its building work emphasis on the Thor or Jupiter, then branch out into an all-French design.

French companies belonging to Force Rockets include: in the missile field, state-owned engine firm, SNECMA, state-owned aircraft firm of Sud Aviation and Nord Aviation, private engine firm, Hispano-Suiza, private aircraft firm, Avions Dassault and they're in the chemical field, Union Carbide, the construction firm, Coustaut and the big chemical firm of Thomsen-Houston and C.S.F.

Atlas Base Construction Force Will Total 1,500

Chesapeake, Wis.—About 1,500 members of General Dynamics Corp. will be assigned here during construction and installation phase of nation's first operational missile facility at Warner AFB. Atlas intercontinental ballistic missile is scheduled for operation from Warner by fall of 1958. General and about 500 persons will form permanent operational force. Construction of two launch pads northwest of Chesapeake will begin this summer. Two more will be built southeast and southwest of the city.



Mold-type projectile tube for the North American X-15 is built to withstand high pressures. Some fabrication techniques such as the X-15 developed from the firm's earlier work on the Navaho and F-100.



Engineers examine part of cylindrical fuel tank for X-15. To give high structural strength, both automatic fusion welding and manual welding are used.



Section weld in nozzle gets close check. All sections are of stainless steel. The X-15 will be subject to significant aerodynamic heating every entire day.

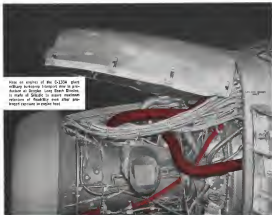
X-15 Rocket Vehicle in Fabrication Stage



Hot nozzle exhaust is used to test wing loading, edge conditions. In constant in constant temperature testing of F-100 components, X-15 test techniques must be modified within specified limits.



High pressure flows running down side of nozzle are tested for hydraulic jacking instead of burned with bolts or rivets. About 50% of components commonly fastened in current craft are instead welded to X-15.



Here is a view of the 5-1204 gas turbine bearing housing, now in production at Bunker Lang Steel Division. It is made of Silastic to meet extreme stresses of double and other gas-turbine engines in engine test.

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First Mono-Atomic Ramjet Vehicle Designed for 59 Mi. Altitudes

By Michael Yaffee

New data on particle propulsion is commanding increasing attention from the Air Force. It is called a mono-atomic or mono-atomic ramjet and derives its propulsive energy from the exothermic or heat-producing recombination of free oxygen atoms in a narrow altitude band at around 60 mi.

Air Force Cambridge Research Center, executive sponsor of the project, is expected to have the first mono-atomic powered vehicle flying in about two years. The Center has contracted with Dr. Paul Blotzek of Research Polytechnic Institute's chemistry department to continue development of his free recombination engine. And Dr. Blotzek has brought in Dr. Ralph Hermon of the University of Minnesota for studies on vehicle configuration.

Earlier, under contract from the Air Force Office of Scientific Research, Dr. Blotzek and his assistant, Dr. Robert R. Reeves, Jr., demonstrated the chemical feasibility of using the oxygen atoms available in the upper atmosphere to propel a vehicle. More recently, their results were essentially confirmed

by Stuart Demetriades and Carl Kerschauer of Aerojet General Corp., who were working on a similar study under another AFOSR contract.

The fascination of the recombination potential is that it could operate forever, theoretically at least, as a free and virtually inexhaustible supply of energy. (In practice the operating duration of the engine will be limited by the lifetime of the catalyst lining its interior wall. In the beginning, Dr. Demetriades estimates that catalyst lifetimes will be restricted to a matter of months.)

At altitudes above 50 mi, dissociation of oxygen molecules begins to appear. Ultraviolet rays from the sun cause this dissociation, forming in effect a streamer of solar energy. Upon recombination into molecular oxygen, two atoms of oxygen yield 135 Kcal/mole O₂. From 50 mi up, it is believed that all oxygen is dissociated. And at 61 mi out, the concentration of atmospheric oxygen drops significantly, 10% of available oxygen in the form of dissociated oxygen molecules, according to estimates by Demetriades and Kerschauer. Visible proof of the existence of free oxygen streamer was provided by



Bunsen Automatic Hangar-Launcher

Boring, Bunsen B-49 interceptors reside in Bunsen, this automatic hangar-launcher. In total range from Cape Canaveral, Fla., Bunsen has been held in readiness overnight waiting for a target to appear on radar. Then, at 90 mi, launch opens, usually in control and fixed. Aerojet-General rocket booster lifts vehicle off and 4 min on its back until two Shugart rockets take over for Mach 2.5 intercept flight. Size of the modification can be judged from Bunsen's 47 ft. length, 18 ft. span.



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a Cambridge experiment performed in March, 1956. Scientists released atomic nuclei from an Avian-B11 rocket at an altitude of 61 mi. The nuclei nuclei obtained the recombination of the atoms into molecular oxygen with the accompanying release of energy in the form of visible light. The big problem was figuring out a way to use this energy as a practical propulsion source.

As early as 1953, Dr. Harter suggested the use of a catalyst to recover the energy atoms inside a living, duct configuration, similar in nature to a pump. The recombination heat liberated within the duct would expand the incoming air, mixing it to move out the next opening with sufficient thrust to propel the vehicle.

Also noting a number of possible catalysts, Dr. Harter and Dr. Baran decided that gold was the best material for their purposes. It catalyzed almost all oxygen atoms falling in surface back to molecules, but the worst bent back through oxidation and, as a result, produced the highest temperature of any catalyst of the comparatively low pressure that would be encountered by the nuclei.

Small Thrust

But even with the high efficiency of a gold catalyst, the maximum possible thrust would be small because of the low concentration of the available oxygen atoms in the upper atmosphere. This means that the nuclei itself must be extremely light. According to Deane Roden and Kenneth H. Hinkle, weight for such a vehicle is about 4000 lb. or so (10 mg per square centimeter of 100-pounds per square foot).

Moreover, materials used in construction of the vehicle will have to withstand internal operating temperatures between 500C and 600C. And to avoid preheating the incoming air, the heat part of the engine must be made of a material that has no catalytic effect on the recombination of oxygen atoms.

To meet all these conditions, Harter and Baran decided to use aluminum tubing in the construction of the engine, covering the aluminum frame with thin sheets of zinc and gold-plating it as required.

The aluminum proved almost completely noncatalytic and could be obtained in tubing weighing about 100 mg per meter. The zinc was used because of its superior high temperature properties and the fact that it was available in sheets as thin as 0.001 in. Eventually, work, the gold, applied to its catalytic effect, was placed by exposure onto the zinc.

Harter and Baran, however, neglected to take into account the differences in coefficients of expansion of the three metals. When the model was heated, the aluminum frame expanded

faster than the zinc lining, and the thin zinc, and gold-plating it as required. Alloys now proposed to use only one material for housing, either aluminum or zinc sheets encased. The RPI scientists through aluminum and much greater flexibility, they find that the superior high temperature properties of zinc are important enough to keep the more brittle material in construction.

Another important item in this development program that cannot be left out is the question of how fast atomic oxygen molecules both in the atmosphere and on catalytic surfaces. Although there has been much theoretical work and fairly some direct investigation of the subject, the approximate rates of atomic oxygen are still matters of speculation.

There are three ways in which oxygen atoms are contained in the upper atmosphere. The most important of these is the formation of molecular oxygen (O₂) and ozone (O₃). The rates at which these nuclear oxygen are important in determining the concentration of oxygen atoms at a given level in the upper atmosphere, i.e., the number of recombined oxygen atoms left. And the concentration is important in determining the thrust that can be developed by a streamtube engine.

Too, the accurate rates are important in the design of the powerplant. The efficiency with which the heat of recombination can be converted into thrust depends primarily on the recombination rates of atomic oxygen. And knowledge of this efficiency is a prerequisite to the design of a streamtube engine.

Experimental investigation of these recombination rates is now underway at both RPI and Aeronautics.

Harter and Baran have made several models of this type. But these models were designed primarily to test heating effects and analysis of construction. Nevertheless, designs for the vehicle are now being studied by Dr. Harter. The final configuration will be determined by detailed wind tunnel testing, on which wind tunnel, substituting for air, will be "pushed" by rapid recombination in a liquid nitrogen cold trap. (The reason for using this substance is its comparatively low cost.)

Regardless of its exact final shape, each vehicle must have an entrance port, a control reaction area and an exit port.

The vehicle will probably have a supersonic inlet diffuser and a supersonic exit nozzle. To Harter and Baran this suggests a vehicle with the configuration of a cylinder or a cone tapered at both ends and slightly tapered at both ends.

The vehicle will probably be collectible or at least small enough to fit

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inside the protective nose cone of a cruise rocket. Without any mass of propellant in the lower atmosphere, the vehicle will have to be carried to operating altitudes and, because of its light structure, will have to be protected on reentry.

Actually, the experimental vehicle envisioned by Bartlett and Reeves is a disk only one foot in diameter and a cross section and weighing 5 oz. or less. It would operate at an altitude of 70 mi. or so, with its internal temperature at approximately 5500° which have to be, at velocities of Mach 2 or less. Individual unit could carry payloads of only a few grams. But a number of vehicles might be wired together to produce a serial though still small overall payload capability, Dr. Bartlett suggests.

Will It Fly?

Bartlett and Reeves state that a model powered by the action of decomposition of dissociated oxygen molecules is feasible. Their reasoning:

It is assumed that the vehicle will fly at an altitude of approximately 70 mi. above the solid propellant is about two inches. At this altitude, one cubic meter of air will weigh 3.6 mg. and will contain 20% oxygen by weight.

If 50% of the oxygen is dissociated that weight of the free oxygen atoms will be 4.36 mg. This is equivalent to 1.1 colors of heat of dissociation for each cubic meter of air. (This checks fairly closely with the 10¹⁰ cal. per cubic centimeter estimate of Dr. Bartlett and Dr. Bartlett's own figure of 10¹⁰ cal. per cubic meter of heat of dissociation. Now all the air will come into contact with the catalytic lining, so even with an efficient catalyst, only 1 cal. of the available heat may be recovered.

Assuming that the vehicle will be 10 sq. ft. in cross section and will fly at approximately 1,120 ft./sec., it will take 14,120 sq. ft. of air every second. From this 14,120 sq. ft., the vehicle should receive 400 colors of heat of dissociation. A reasonably efficient engine will convert 25% of the available energy to thrust.

But even assuming great efficiency and no losses, say with only 50% conversion, and taking drag into account, the engine will produce a thrust and lift equivalent to 1.2 oz. (40 grams) and a 1,200 gram weight. And it is possible to build a vehicle, the RPH accounts say, that weighs 15 oz. or less with readily available material.

Attacking the problem from a different angle, Bartlett and Dr. Bartlett's own estimate of the same figure, it is not the same conclusion. This is, that a 300% efficient nuclear fusion engine will produce a thrust of 40 dynes per square centimeter of solid core at an altitude of 40 mi., and that it is possible to obtain an operable engine with a thrust of about 4 dynes per



Dr. Neville A. Peake (left) discusses Earth-orbiting system with Donald M. Bartlett.

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decade of research and development in every phase of propulsive flight. Plans for new and even more advanced and economical aircraft are on the drawing boards at Lockheed—so give vital tactical and logistical support to our fir-

ing NATO allies here, our missile-launching mobile units of the United States Armed Forces, and the thousands of talented men whose produce the armaments to maintain America's defense at optimum strength.



*Military aircraft never establish official speed records until they have been operational 1 month.

Lockheed's famous "Missile with a man in it," the F-104 **STARFIGHTER**, entered USAF service in February. Every time it flies an intercept mission for Air Defense Command, the F-104 exceeds the world's official speed record (1207 miles per hour) for jet aircraft.*

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square centimeter of solid area. The aircraft cost about \$10 million, this week out close to Lockheed's figure of \$12 million (\$14 million).

This thrust compares favorably with the maximum thrust of the expected 60,000 lb. for a light speed below Mach 10. And the thrust-to-drag ratio is the most important factor in determining the feasibility and operation of such vehicles. The Aerojet engineers have not, and that operation of the vehicle is "not much guesswork" because of the extremely light structural weight required.

Limited Speed

The theoretical test described and Kirtland's test in the future was the development of a recombination engine that would fly at speeds close to Mach 10.

After an intensive investigation, they concluded that this was impossible.

The limiting factor here is the ratio of the engine's mass to length. In order to achieve a thrust that is larger than the drag, the length must be less than 0.7 as long as the engine. At the same time, for a catalytic recombination engine to operate at this altitude and speed, all recombination energy must come in contact with the catalytic bed, and this requires a length of 17 times the engine. Obtaining recombination by compression is likewise unfeasible, say the Aerojet engineers, because there is no difference which can compress to 1,000 to 5,000 times with a length-to-radius ratio of only 0.7.

Herbert and Kirtland agree that it would not be possible to fly a recombination engine at a velocity of Mach 10 in practice. But it seems very likely that such a vehicle will operate at Mach 2 or under and, even if these comparatively slow speeds, will prove a significant development.

The vehicle will be incapable of building and not willing to operate. Its light construction will be adequate for its low pressure operational environment. It is lightweight, the small payload and equipment, and limited vehicle lifetime can be ignored. And, unlike an artificial satellite, it will not have to fly in a fixed orbit. But, most important, the recombination engine opens up a new and potentially significant area of propulsion, with the Navy leading the way to more sophisticated and practical possibilities.

Taking it into the atmosphere, Kirtland and Kirtland also see some hope for the high-speed recombination engine. On Mars, the presence of large amounts of atomic hydrogen (which has a heat of recombination about twice that of atomic oxygen) would make it possible for the engine to propel a vehicle at sustained orbital speeds.



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lowside shock return system of the rocket.

A third shock in the system occurs ahead of the conical jet, so that it separates flight speeds and distance in operating with flow spilling onto the conical.

In spite of the apparent aerodynamic complexity of the system, the test program was successful. During one flight test at Mach 1.8, pressure recovery readings at the face of the inlet (inlet) showed diffuser efficiencies of about 0.9 and for the bypass air showed efficiencies each slightly lower.

There have been no indications of flow instability in the swept section such as would produce "buzz" at the inlet by alternately accelerating and decelerating the shock.

So far, Wood engineers have seen no need for modification of the present inlet configuration, although it has been proposed in one case. It is possible that for the higher speed regime, the inlet air pressure loss cannot be shied, so the simple pilot inlet can have a change to a more sophisticated type.

Diffuser efficiency cannot be plotted against Mach number, generally, at high and fast for a small portion of the speed range, and then drop rapidly. The Griffin inlet is obviously operating on the high portion of the curve now, but if the flight envelope is extended much further, it will start sliding down toward low efficiency. For the moment, a central control face back may be necessary to generate a second inclined shock system and further reduce the approach. Much remains so that the efficiency concept again.

Powerplant Tests

Before the Griffin B, under the first of its tests, the powerplant had been tested on the ground in simulated flight.

The aircraft, almost exactly as it is on the line, was built in just a few days and powered solely by the Air engine. That is, the Griffin I, first test, first test, 1955. The major aim of the flight test program was to obtain data on the aerodynamics of the engine, unaided by what then the uncertainties of inlet system.

The powerplant of Griffin II was tested in a complete facility in the test tunnel of ONERA, the French equivalent of NACA, at Modane, by which, shutdown and sustained operational conditions were produced as the tunnel for the fuel and oxygen, and for both together. The reason of this test proved the way for the flight tests of the second phase of Griffin development.

Modified to take the complete power plant, the first prototype Griffin I became the second prototype Griffin II.

For flight tests. It made its first flight on 23 July 1955.

First target ignition was made on the 27th flight, using a pilot light to ignite the rest of the circuit. On March 15 during the 12th scheduled flight the target was ignited electrically in the test area, without the pilot light.

Two days later, the Griffin made through March 1 on its 20th flight with the first test pilot Andre Tardieu at the controls.

First phase of the flight test program ended on 6 and the engine went into the shops for modification of the air intake. With a larger inlet area, the flight envelope was gradually extended until March 13 was reached. At that point there was a second test with a pilot engine and pilot light, a good look at the results, because they wanted to avoid the phenomena that had made trouble for other planes at that speed.

Nothing showed in the test results to indicate any problem. The engine and Tardieu, in one test, rolled the turbine at Mach 1.6. The flight test program was to be terminated at Mach 1.8, primarily for reasons of burning on the engine, and that came on Dec. 9 last year when Tardieu rolled over in a climb at that speed. This marked the end of the first phase of the Griffin flight test program.

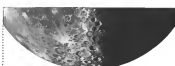
Only major change during the flight test work with the Griffin II was an enlargement of the air intake, there were no configuration changes in the engine except for minor refinements and control changes. Wind-tunnel tests on the Griffin I, were not installed on the Griffin II. They may be needed in later flight test work in both altitudes and speeds are increased.

Observers expect that the next development phase of the Griffin will be to install the Suezor Super Air, the so-called "all-star" engine designed for the Mach 2 or 3 engine. That engine is considerably larger than the Air I, 5 now in the Griffin, and would demand a much larger powerplant bay, and as such, the Griffin configuration, with its cockpit, derived from the present, will be relatively easy to modify to take the bigger engine.

Ready To Go

There are some aerodynamic similarities between the Griffin in its present form and New's performance delta design 1402 "Griffin." Both have similar delta wings and swept vertical tails, both have straight through power plant systems. Consequently, the flight test program of the Griffin contributed greatly to the background and experience of pilot Tardieu and the engineers working on the projects.

The two planes differ in powerplant and in longitudinal control systems. The Griffin used a small delta delta



A quiz for Rocket Propulsion Engineers

(Time Limit: 10 years)

1. What is the maximum theoretical specific impulse obtainable for a rocket motor with zero combustion velocity?
2. What are the basic mechanisms involved in jet separation in rockets, and how can the separation point be predicted as a function of nozzle divergence angle?
3. What is the effect on nuclear reactor design of a working gas which is self-heating and changing its composition?
4. What are the dynamic instabilities among the various components of a rocket engine, and what control systems will best solve the rocket engine control problems?
5. What is the flame holding mechanism in a rocket motor and how can fundamental understanding of such a phenomenon be used to increase combustion time?
6. What types of fluid transport systems offer simplicity, efficiency, and light weight (other than the conventional turbo-pump)?
7. What are some workable methods of transferring chemical energy into thrust—other than by the standard combustion at high pressure and then conversion to velocity?
8. If you would like to work in these areas and have an outstanding technical background, an inspiring mind, and the freedom ability to visualize new solutions, possess a M.S. or Ph.D. degree in Physics, Chemistry, M.E., A.E., Ch.E., E.E., or a B.S. degree in the above with a thorough background in applied research, we have a place for you at Rocketdyne.

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CENTER wing section of the Electro has large tapered fuselage faired in front and rear spans.

wing. Modifications in this attachment and fittings were made in five areas. Main and rear leading gear were exhaustively checked in fatigue tests. Leads were introduced to simulate actual landing, braking, engine stop and towing test maneuvers, such as turns. In all, about 93 different loadings were used to simulate the spectrum associated with one flight.

Main landing gear already has more than 750,000 simulated flights, classified as segment 1, with no major difficulties encountered. Nose gear has successfully been put through 500,000 simulated flights and results indicate it barely has started life.

Other gear tests included drop tests to establish surface loads for landing impact absorbers. Simple wheel plate was found to be satisfactory for main landing gear, while nose gear required use of a tapered rotating pin in one location with the wheel plate.

Electric nose gear steering motor and detector danger are combined in a single unit. Each tests on complete nose gear in Lockheed's dynamic tests. Induced steering, differential steering from two track machines in the system. Steering mechanism was redesigned to eliminate objectionable friction, design then was tested for shunt and pivot angle.

Fuselage Pressure Tests

In full-scale fatigue tests Lockheed engineers are imitating Electro loads in operating power, spring loading, loads which would stress legs and struts during this loading condition. This is the first test. Lockheed has used in other fuselage tests a method to air pressure buildup for this type of testing to completely simulate severe operating conditions.

About 36 sets are being put at critical areas. One of these locations is the lower, tapered main frame for fuselage to wing attachment, which will be severely compressed. Other locations include window frames, windshield posts, fuselage ribs and frames, and corners of doors.

Wing fatigue tests have been completed and original design essentially has been verified. Tests show that full-scale requirements of shear webs, spar caps and integrally stiffened surface structure have been exceeded.

For fatigue characteristics in the windshield, construction compares an outer layer of 3 in. Noya boron resin tempered glass backed by a 1/2 in. metal followed by a 1/2 in. full tempered glass outer pane, and inner pane of 3/8 in. glass separated from outer pane by 1/2 in. void. During tests, all glass panes were deliberately failed and it was shown that outer alone was sufficient to

carry up to twice cabin operating pressure. Test report test results detailed use of the boron vinyl and 3/8 in. glass to contain any broken pieces of main pane, preventing further loss of cabin pressure. Without these resin cap glass layers, flying particles of resin pane, simulated simulated pilot (air duster).

Fuselage cabin window composite bonded-in-place Pileguard 77 in two pieces—5/16 in. outer sheet and 25/64 in. inner sheet. Outer pane normally comes under pressure. In full-scale demonstration, outer pane was deliberately failed under twice the cabin operating pressure and inner pane withstood the load although it had been previously scored and punctured to simulate possible service abuse.

During the distribution of engine bleed air for cabin wing wing and wing pressure loading edges was designed as a tension system with each door independently flexible since in the primary heat-out at each engine near in bleed gas, manifold. Some displacement changes in the system due to thermal expansion, wing flexure and engine motion must be taken in leaving high strength structure and doors were used for the distribution lines.

Complete makeup of the system was opened under simulated wing conditions to verify structural integrity. In addition, the portion of the system in the engine was fatigue tested under full air at maximum temperature and pressure by cyclic varying engine rotation.

Thermal Makeup

Aluminum foil-like thermal makeup is being used to check and refine air conditioning (heating and cooling) installation. Cooling about 5120/000, this specially constructed and applied, a 40-ft long section of the Electro fuselage completely furnished on the inside including cabin floor, insulation, carpeting and lights. Hot or cold fluids are circulated through metal tubing on the outside of the skin patch to produce temperature stages for various time periods in simulated flights. Makeup is constructed on its own to remain nonexpanding, nonshrinking in cabin. Tests during the past year have proven system performance and have resulted in improvements over original specifications.

To determine acoustic characteristics of the bare fuselage and the fuselage with insulation and interior trim, Lockheed constructed a nacelle fuselage section about 12 ft long, containing about 5190/000. Tests are being run with sonic source spanning a spectrum from about 50 cps to about 4,000 cps. Effects of frequencies above 4,000 cps can be readily predicted under these conditions, since type of acoustic

treatments have been checked. Results have given an optimum distribution for weight of fiberglass used in cabin insulation. Also, it has been found that use of molded rubber foam patch provides in some degree the effect of using a double-skin structure. Insulation, tape and trim have been fitted, but tests are being continued to achieve possible improvements for future Electro.

In addition to the program on the acoustic makeup with external noise source, hydraulic makeup also has been used to determine sound levels under long term operation of pumps and fans under maximum thrust loads. This has

resulted in development of pump fan enclosure, pump vibration mounts and acoustic filters for turbine lines.

Tests indicate that Electro will be 15,000 cfm for takeoff and 15,500-cfm for cruise. Four-blade propeller will be operable longer than a 1049C Super Constellation with 11,000 hp and 15.2-ft, three-bladed prop.

First flight test Electro is not completely finished, but second measurements indicate that target loads will be met.

In engine supporting structure, stress load test is used when operating test procedure and test buses requirements must be met. Therefore it is required for



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by positioning this valve accordingly.

For cabin cooling, air side system can reduce cabin inlet temperature to as low as 5°F. When additional cooling is required because of high ambient temperature, such as on the ground, three vapor cycle systems operate automatically to maintain desirable cabin temperature and humidity. Flight turbine has air conditioning system separate from main cabin system. Cockpit has frozen evaporator, economizing fan and electric heating element.

Cabin pressure is supplied by two compressor groups to absorb expansion with air supply taken from engines, main air intake. Compressor system also de-

signed for parallel operation but can operate independently. System can maintain cabin at pressure equivalent to 15,000 ft. During operation up to 15,000 ft., one of six level valves alternate up to 15,000 ft., with other one at two compressors.

Electrical system incorporates three diesel-driven and one gas-turbine-driven 60 kw, 400-cycle a/c generators, one on each engine. Each generator supplies power through a three-line output. To ease of failure, loads are switched to remaining generators. Emergency power is from battery or motor.

Direct current power is obtained with two 115-volt, transformer-rectifier units providing 38 volts. Each unit can handle all d.c. loads.

Thrust fuel system incorporates two integral tanks in two forms of each wing, independent, accessible and plumbing for each engine, isolated system, single point underwing pressure feeding, pressure as well as non-pressure feeding, fueling, storage, main, behind wing tank, holds 1,000 gal., auxiliary tank, holds 1,500 gal. Expansion space is equivalent to at least 7% of tank gross volume. Each of the four wing tanks feeds fuel to one engine, with all tanks connected to a common manifold for feeding fuel from one tank to one engine.

Single point underwing fueling is controlled by No. 3 engine nozzle. Flare to one tank can be shut off in fueling, or tank flare valve automatically will reduce fueling rate at 90% tank capacity and shut off at full capacity.

Thrust shafts, equipped with flame arresters, is provided in each side of the aircraft to serve the two tanks in each wing. Thrust system uses pressure feeding, manifold, hence is safe material, tested for leaks each time underwing fueling system is used.

Thrust engine system is constant flow type, includes 38-in. ft., 1,500 psi storage cylinder, continuous-recycling catalytic pressure gas, in valve and at engine location, regulation, etc. Portable oxygen cylinder (11 cu. ft.) with both demand and constant flow switch is located in cabin for emergency use. Cabin oxygen system is gas inlet, holds 18-in. ft., 1,500 psi storage cylinder, has flow differential manual regulator. Flight station also has 11 cu. ft. portable oxygen cylinder. Altimeter, elevator and rudder control systems incorporate cable installations to monitor and push pull rods to control surfaces. Boosters gas inlet deliver master fuel. Each booster includes emergency bypass mechanism.

Speed brake flap controls operate through arm cage and is connected with wing flaps by means of automatic control system, which disengages when wing flap is operated.



Fueled by the straight wire aerial, special purpose antennas have developed into storage and release shapes. Portable support antenna (top) is in use in Maine to receive 400 mc signals passing the ocean from transceiver 14 mi away. Straight wire array (bottom) is used similarly by Naval Research Institute in early 100 mc signals received by the moon and return back.



Special Antennas Require Novel Configurations

Designed to provide more sensitive antennas on the VHF/UHF range, the twist antenna (above) is an improvement of the common parallel rod type. Extension beyond normal wire length is possible because the cross rods twist in a spiral about the axis. Special configurations above it 16 ft. long but can be used in many times this length with corresponding increases in antenna gain. The advantages of this type of antenna is that it can be used in many installations normally requiring expensive and cumbersome parabolic antennas. Test antenna shown at supported on derrick.

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More than anything else, this meant achieving increased capacity

of size and weight. Along with improvements in quality and constantly expanded output, we have worked always to make smaller and ever smaller components without sacrificing performance standards in the slightest degree. As electronics became a full partner in the booming aviation and missile industries, the need for smaller electrical components continued to grow. We supplied them. The industry taught them.

Result: We are engaged in the greatest plant expansion in our history — it is to be devoted to vastly increased production of *new* electrical components. Only your confidence in the quality of all the connections made by Scintilla Division of Bendix Aviation Corporation — and in the integrity of the people who work here — has

made this expansion possible. We shall endeavor to continue to meet that confidence. SCINTILLA DIVISION OF BENDIX AVIATION CORP., HAWLEY, N. Y.

Scintilla Division, Bendix Aviation Corp., 300 Executive Blvd., Hawley, N. Y.



Scintilla Division
Bendix, NEW YORK



AVIONICS

AMB Outlines Bid Award Method As Aid in 10 Procurement Plans

By Philip J. Kline

Washington—*Aerero* Modernization Board has outlined details of the procedure it will use in picking winning contractors for its major development and which was used to select General Precision Laboratories over 17 competitors to develop AMB's new automatic data processing outfit. Information is reported to be helpful to companies planning to bid on 10 other major procurements which AMB plans for this year.

Agency technique of using quantitative rating to separate groups of entries in an adaptation of proposal evaluation procedures used in major Defense Department procurements. Procedure was outlined last by Col. Carl Fisher, AMB project manager on the data processing program and chairman of the evaluation group.

AMB decided in advance to evaluate data processing system proposals on the basis of three major factors:

- Operational complexity.
- Technical excellence.
- Company background, including how people who would work on the project.

Contractors were asked to submit their proposals in three separate bundles each corresponding to one of the three areas to be evaluated. Those proposals dealing with operations were awarded first.

Each evaluation group consisting of six men, was headed by an AMB expert. Majority of the final candidates were selected from those recommended for the job by the three military services and the Civil Aeronautics Administration, in response to an AMB request. Group that made the operational evaluation, for example, was headed by a former CAA traffic controller on leave from the Air Transport Unit. Two others were CAA traffic controllers on temporary duty with AMB. Remaining three members were military pilots (two Air Force, one Navy), two of whom also have civil control experience.

Evaluation procedure proposed by Fisher called for a preliminary elimination in event that more than 15 entries in proposals were received. Although only 14 came in, five of the 14 were dropped after initial study because one at issue of the evaluation groups unanimously agreed they were inadequate

and failed to meet the agency's requirements.

Proposal of each bidder in automatically studied by all members of an evaluation group and a decision is made to accept or reject, before proceeding to the next company's proposal. Decision to reject a proposal during initial phase requires evaluation group to write a statement giving reasons for its decision. Proposals that are not first handled are then studied individually by members of each evaluation group, rated "too difficult," "average" or "good" by each member of the group according to a number of criteria on a formal rating sheet.

For example, operational evaluation of the second data processing proposal was based on the following criteria:

- Understanding of operational problems.
- Meeting user requirements, with separate ratings for military, general aviation and commercial users.
- Safety relative to present system.
- Ease of processing control.
- Capacity relative to present system.
- Traffic rate relative to present system.
- Efficiency of airport use.
- Ease of transition from present system.
- Rated as coordination with air defense.

Technical Evaluation

The diverse technical evaluation group prepared rating sheets which called for similar appraisal of the following factors:

- Understanding of problems.
- Technical feasibility of proposed solution.
- Completeness of engineering proposal.
- Effect of component failure (on system operation).
- Reliability.
- Expandability.
- Flexibility.
- Ease of maintenance.
- Man-machine relationship.
- Time schedule.
- Feasibility of first plan.
- Assessment of design required.
- Availability of CEE equipment required.

Third AMB evaluation group conducted each last three rating sheets, one intended to assist the corporate engineer and facilities in the data processing field, the other to evaluate the



But the Navy's F-4 Phantom II fighter plane has the potential power of the moon every time. It's Long, 60' 11" L, 40' 11" H. Then, long-range patrol craft don't need sign posts or markers to stay precisely on assigned routes.

Scintilla Corporation's DE-AD (DEAD-ON-TRACER) (DE-AD) — aboard every Super Constellation that flies AMB point-to-point — from out as a Minuteman about a permanent record of the plane's flight path. The DE-AD continuously provides a constant and accurate picture of the plane's present position. While this information is being sent out on the clear electronically and simultaneously, three digital displays of longitude and latitude are displayed on the computer console as well as remote indicators.

Scintilla Corporation developed the Dead Reckoning Tracer in 1945. It was the service in 1945 the Navy has used the Scintilla DE-AD (the most accurate electronic system developed anywhere in the world to date).

Best use of the continuing performance of the DE-AD (DE-AD) is Scintilla Corporation is now developing a smaller, lighter weight model for light aircraft — under Air Force contract designation AN/APA-130 DE-AD.

For information on other advanced navigational aids and systems developed by Scintilla, call or write.



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A report to engineers and scientists from Lockheed Missile Systems—where expanding missile programs insure more promising careers

COMPUTER "FLIES" MISSILE DESIGNS, SPEEDS POLARIS DEVELOPMENT

A new analog computer is today speeding early development of the Polaris ballistic missile by virtually "flying" missile designs right off the drawing board. These "test flights" eliminate design flaws and come up with a workable form without wasting time and money building and flying proposed missile shapes. Two Univac Scientifics are also included in the designer's computer facilities—already among the most extensive in the west.

Advanced facilities like our computer installation have been developed through expansion in a variety of missile programs. These missile projects—including Polaris, X-7 and Q-5—have earned Lockheed leadership in missile technology. More advanced projects we cannot talk about are under way. This means engineers and scientists who join Lockheed Missile Systems now can enjoy opportunities to grow rapidly in the years ahead.

Positions are open for qualified people in: Information Processing, Telecommunications, Radio Relay—Production, Ground Support, Guidance, Flight Controls, Aerodynamics, Thermodynamics. Write or send resume to: M. W. Pearson, Research and Development Staff, Sunnyvale 31, California.

Lockheed MISSILE SYSTEMS

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION
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Group leader Robert Turner, right, discusses results of a problem with Staff Analyst Richard Hayes.

under skills of individuals whom the company proposed to assign to the project. Expenses as talent factors listed on the corporate rating sheet and duplicated except for facilities and delays caused in the individual talent sheet, included:

- Data processing.
- Design.
- System work.
- Fabrication.
- Field engineering.
- Simulation.
- Flight test.
- Traffic control work.
- Knowledge of New York area.
- Fabrication facilities (concurrent).
- Test facilities (concurrent).
- Record of on-time deliveries on government contracts.

When each member had finished rating all proposals he placed the rating sheet in an envelope without disclosing scores to other group members. Envelopes were sealed, collected by group chief, delivered to evaluation team chairman Fisher unopened.

Weighting Factors

Recognizing that an "inherent" rating for system evaluation criteria should carry greater weight in the overall score than the same rating for another criteria, AMB set up a point-weighting system which was shown on the rating sheet. For example, an "excellent" rating on computer experience in data processing might be worth "X" points, while an "excellent" rating in flight simulation might be worth only "X/2" points. As might be expected, computer's scored for system definition rated a high weighting factor because of AMB's short program timetable. (AMB declines to release specific weighting factors used.)

In writing its composite score for each company's total proposal, a formula was employed which gave equal weight to company's individual score for each of the three major evaluation areas (i.e., operations, technical and computer background). However, since the had been given each company's composite score was determined by multiplying—and adding—the weighted scores in each category for the three individual portions of its proposal.

This method of combination was intended to prevent a company with a very low score in one of the three areas, but high scores in the other two, from winning off with the competition. For example, a company's technical proposal and operational concept might be excellent, but if it had an extremely bad record of late deliveries on previous government contracts, chance was that it would not meet the critical timetable which AMB has set for the program. (AMB does not intend to



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Short Circuit Mintorque 0.05W to 1W, Microtorque 0.1W to 1W

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Defense Department records on one party deliver performance).

Only after the composite composite issues are determined, and compared, does joint come up for consideration. If the top seven's price is comparable to the second place bidder, the award goes to the high-ranking proposal. If two top companies have nearly identical scores on their proposals, then price may be the determining factor. The important thing is that some of the experts who evaluate the proposals are expected to price considerations during their evaluation.

Specific criteria which will be used in rating each of the upcoming ANM procurements naturally will differ somewhat from those employed in the data processing version comparisons. However, America's Manufacturing Board plans to employ the same scientific approach to weighing objectively all significant factors in entering the winning bid.



■ **Airbus Flight Recorder**—Aeronautical Radio Inc. will hold airline industry working April 9-11 in Washington to draw up specifications for an airborne flight recorder capable of storing an hour's operational needs as well as new Civil Aeronautics Board regulation calling for use of recorder on all aircraft operating above 3,000 ft., effective July 15. Manufacturers interested in attending should contact William Corbett, Anne, INO "K" St. NW, Washington.

■ **Ally Well Self-Clean**—Aeronautical Radio's Airbus Electronic Engineering Committee has worked out details of a modified version of Alky's selective calling system which will permit ground stations to interrogate and on mode airplane and get an automatic "Ally Well" reply without any pilot action. Original Self-Clean and Ally Well modifications, patented by Pan American Airways, required assignment of reciprocal code for the latter which made industry-wide code assignment more difficult. Tech. agree evolved by Anne's AERC for getting around this problem, such as addition of another set of tone signals in the 1,800 to 3,000 cps band.

■ **Working's Off-Letter Industries** and Aircraft Radio Corp. have called off plans to merge, before an influx of sufficient number of ABC stockholders to put up stock for exchange for Litter stock. Earlier proposed merger between Airborne Instruments Laboratory and Aircraft Radio Corp. failed to materialize for similar reasons.



Key Openings for Electronics Engineers

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- Aircraft Design Engineers**, E.E. or Physics Degree with emphasis and aptitude for aircraft design. To join active projects involving design of fuel-injection, control and external systems in all disciplines for very high-performance aircraft and missiles.
- Fire Control and Missions Systems Engineers**, Engineers E.E. or Physics Degree, at least 3 years experience in radar, gun link, or fire control systems, and strong ability in this work.
- Test Equipment Engineers**, Engineers E.E. or Physics Degree and at least 2 years experience in the test or related field. (Some ability broad background in electronics design with emphasis on digital computers or microwave systems.) To join in the design of complete checkout systems for missiles and aircraft subsystems.
- Guidance Design Engineers**, E.E. or Physics Degree, plus 2 or more years experience. To design various active and self-contained missile guidance systems, and in design and design radar beams.
- Reliability Analysis**, Engineers M.E., Physics, E.E., or Math Degree, broad knowledge of electronics and mechanical systems; experience in operations research or reliability. Helpful: statistical methods experience.
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The first of the Navy's rocket-driven subs, designed to roam the seas as silent Republic II bases, is now in construction. The missile stock has more than 25 successful flights. Under Navy leadership, it will be a relentless watchdog for peace.

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The Year Advertising Helped Kill a Business Recession

IN 1954 we had a business recession in the United States. Sales fell about 4% during the year. If management had followed the historic pattern of business ups and downs, advertising volume would have fallen much further.

But in 1954 the volume of advertising did not fall. It increased over 3%, and expenditures in all major advertising media rose. Every effort was made to stimulate sales when sales were needed to survive properly.

That was something entirely new under the sun. It had a powerful influence in staking the recession of 1953-54 one of the mildest on record. It helped greatly to speed business on to the record-breaking levels it attained in the years 1955-57.

There are several reasons why America's business managers attacked that decline in sales with more advertising. One of them grew out of the greatly strengthened position of the American economy. Another: Consumer income after taxes has been rising an average of over \$16 billion a year since 1946, and that rising income is more widely distributed than ever before. Furthermore, consumers had piled up reserves of about \$200 billion in cash or its equivalent. These reserves offered a new and powerful instrument to increased selling and advertising effort even in the face of a possible decline in consumer income. (At the end of 1957, consumer reserves were \$225 billion.)

Taking the Longer View

However, the principal reason why a sales decline was attacked

This editorial message was first published by McGraw-Hill two years ago. It describes advertising's dramatic contribution to the American economy during 1954. The theme of the editorial—that advertising can help promote economic stability by stimulating sales at a crucial time—is even more pertinent today.

As our economy grows, it is constantly changing. The conditions business faces today are not the same in every respect as those it faced in 1954. But business again has the opportunity, through advertising and other selling efforts, to help maintain a high level of economic activity. At the same time, it will be building markets for the period of renewed expansion that is sure to follow.

This editorial is reprinted exactly as it appeared in 1956 except for minor editorial changes to bring it up to date. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

McGraw-Hill Publishing Company, Inc.

with increased advertising is management's long-fused conviction that good advertising is essential to expansion in the development of a market. Successful development requires sustained investment. The maintenance of business management to take this longer view is, of course, motivated

by the fact that the American market, with over 5 million consumers being added annually, is growing at a prodigious rate.

Ten years ago only a handful of companies had plans for investment in new producing facilities extending beyond the current year. Today almost all leading companies have investment programs running some years ahead. And keeping pace with these long-range investment plans has been the development of sales and advertising programs to reach consumer's greatly expanded markets.

Advertising's Key Role

The crucial role of advertising in providing driving power for our economy is gaining greater recognition every day. In his book, "People of Plenty," Professor David M. Pester of Yale University attacked: "Advertising is not badly needed in an economy of scarcity, because total demand is usually equal to or in excess of total supply, and every producer can eventually sell as much as he produces. It is when potential supply outstrips demand—that is, when abundance prevails—that advertising begins to fulfill a really essential economic function."

Today abundance so completely prevails in the United States that it has been conservatively estimated that as much as a third of everything offered for sale falls in the realm of "optional consumption." That is, consumers can "take it or leave it" without any immediate personal inconvenience. But if they decide to "leave it," a similar

economic depression will not be far behind. In such circumstances, advertising—in which, in all of its forms, we are now investing over \$16 billion annually—clearly is of crucial importance to our continued prosperity.

In performing its key role in past years, American advertising never realized its full potential. It successfully promoted sales. But a never was called upon to promote an overall economic stability as a direct outgrowth of increased sales.

By successfully promoting both sales and economic stability, as it did in 1954, advertising surely has added new strength to the American economy. It has also added a genuine and constructive dimension to advertising itself.

One of the fastest means of expanding your sales volume in today's red-hot markets is through demand advertising in the publications directly serving your major customers and prospects.

McGraw-Hill's business and technical publications can give you quick access to the men who manage, specify and approve the purchases of industrial products and services. Because all are leaders in their respective fields, you are assured a maximum return on your advertising investment when you concentrate in the McGraw-Hill publications serving your most important markets.

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HEADQUARTERS FOR

BUSINESS INFORMATION



A PRACTICAL SOLUTION TO BLAST CONTROL PROBLEMS

THE LYNNCO AIR CURTAIN BLAST FENCE*

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The Lynnco Blast Fence is available both for heavy jet bombardment aircraft

New off-the-shelf Blast Fence gives full blast control at half the cost

The Lynnco Air Curtain Blast Fence employs a basic principle of aerodynamics to provide effective blast deflection. In addition, the fence acts as a considerable vibration dampener. Cooperation may be carried out behind the fence only 25 feet from the tailpipe.

CHECK THESE FEATURES:

- Low initial cost—no maintenance costs
- No fire-through—no gases, debris or turbulence behind fence

- Easy to install—easy to dismantle
- Lightweight—erects for ease in lifting—no complex movement, roll ends—vibration isolated
- Oil, water or waste gas free, vinyl treated fabric. Available for concrete, self-cleaning delivery

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WHO'S WHERE

(Continued from page 15)

Changes

Dr. John Moore, chief executive officer, The General Corp.'s Aircraft Manufacturing Division, Los Angeles, Calif.

David C. Bader, manager aircraft engineering, Communications Products Department, General Electric Co., Syracuse

Dr. Montgomery H. Johnson, director of advanced research and Dr. Joseph V. Clark, director of missile technology, American Science, Inc., a subsidiary of Ford Motor Co., Los Angeles, Calif.

Reg. Gen. Edward M. Day (USAF), active member of the president's staff, Headquarters and Instrument Corp., Boston

Dr. Harry S. Kottbus, development research department, Military Engineering Division, General Electric Co., Los Angeles, Calif.

A. L. Erik, assistant to the director of customer relations for planning, Fairchild Engine Division, Fairchild Engine and Airplane Corp., New York, N. Y.

Dr. Frank B. Berman, technical director, research and development, General Electric Aircraft Manufacturing Corp., Cincinnati

Stephen H. Carter, director of sales and marketing and general manager, Texas Aircraft Corp., Dallas, Tex.

John E. Chaffin, chief of research, Bell Telephone System, Bell Telephone Laboratories, New York, N. Y.

James L. Jacobs, plant manager, Bell Telephone Laboratories, New York, N. Y.

John E. Grier, assistant to the chief of the Engineering Division, The Road Corp., Santa Monica, Calif.

T. Kent Welch, general manager, T.C. Components Division of Bendix Electric Co., a subsidiary of T.C. Components Corp., Los Angeles, Calif.

Vincent Kirt, director of research and development, Control Engineering Co., Detroit, Mich.

John S. Glen, representative of aerospace electronics, Boston Air Lines, Miami, W. Va.

William E. Cohen, director helicopter engineering, Republic Aviation Corp., Farmingdale, N. Y.

B. J. Anthony, in charge of the newly established Detroit Office, General Motors, Detroit, Mich.

BUSINESS FLYING

Pilot Safety Stressed in Workmaster

Leasair-Prattville project has been selected by Austin Aircraft, Ltd., of a new agricultural aircraft known as the Workmaster. It was designed to the specifications of Crop Culture, a British rural spraying and hay-drying company.

Crop Culture has ordered two Workmasters and a further order for five has been placed by the British rural spraying company, Austin.

First of the 14 aircraft on order made its initial flight Feb. 22, and soon is completing flight trials. Major change in the aircraft is installation of a 150 hp-1600 rpm engine in place of the previous 115 hp Pratt & Whitney engine. The manufacturer says the American engine not only enables the heavy load to be carried with ease but better power is given for increased safety margins.

The Workmaster can carry up to 120 U. S. gal. of chemical and will spray at speeds of up to 70 mph. The chemical tank is located behind the pilot, with room also for a second seat for a passenger behind the pilot.

Safety Features

Crop Culture and Austin put a strong emphasis on pilot safety in design of the aircraft. These are some of the features:

- Chemical tank is positioned behind the pilot, rather than behind, minimizing the risk of injury in an accident.
- Specially shaped tail, provides good visibility when flying close to the ground.
- Jetison valve is fitted to the bottom



WORKMASTER has 150-hp engine, optional chemical tank located just behind pilot and there is space for a second seat behind him. Fully loaded Workmaster is estimated at 1500 lb.

of the tank which will enable the load to be dumped in the event of an emergency. This can quickly increase the rate of climb from 600 fpm to 1,000 fpm.

- Pilot's seat has been strengthened and equipped with a 250 shoulder harness made from chemical-resistant material.
- Throttle, fuel control, and electrical controls, are located in the center of the cockpit.
- Hydraulic system, provides good visibility when flying close to the ground.
- Addition of pressure fuel-feed and over-boost fuel system.

Tail section of the Austin has been redesigned to improve stability at maximum weights where the center of gravity

tends to be aft. Installation of a new caudal fin, more sensitive than the older type, makes the aircraft more maneuverable and easier to handle, according to the manufacturer. Controls also are said to be better housed.

For increased pilot efficiency, a more comfortable seat has been installed and an effort made to reduce the noise level. There are engine air filters for both cold and hot air conditions and an emergency air intake which opens if the other a dogged. Air intake guards are provided for the tail rotor and rotor blades.

Capacity of the Workmaster places it between the lighter Alpha and heavier more expensive Aggro in the



Czechs Test Light Twin

Flight test program is underway on new Moirav B-220 two-place light twin which is expected to have top speed of approximately 155 mph, cruise speed of 270 mph and range of 1,600 mi. It has retractable hydraulic landing gear, control and wing bridle. Designed for business use or test service, B-220 was shown in public during recent engineering exhibition at Brno, Czechoslovakia.



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Aviation stable of agricultural aircraft. Cost will vary between \$10,200 and \$14,000 depending upon the equipment selected. Aviator now dealers now can be made in 12-14 weeks.

Short Takeoff

Proving flights have shown that the aircraft can take off fully loaded after a 100-yard run, the manufacturer says. This is followed by a steep climb out, 1,000 ft/min during spooling up, so that it is estimated at three minutes.

The Workmaster has a wingspan of 36 ft, length 23 ft, 7 in. Its weight is 2,550 lb and it can carry a payload of 350 lb in addition to the pilot. Maximum level speed is 164 mph, with a maximum cruising speed at 55% power of 86 mph. Fuel consumption at economic cruise is 74 gph.

Fuel tanks, totaling 58.4 U.S. gal., have been shifted from the fuselage to the wings in the new model. A constant speed propeller is standard equipment.

Controls have been positioned so that throttle and gear pitch both can be handled with one hand.

Aviation and the Looney's power/weight ratio was better than that of any other engine available.

Fortunately, when Coop Culture came along, the right engine came along at the right time, a company spokesman says. "For some time in this country, we have been sadly lacking in engines of the right power/weight ratio and cost. We also were fortunate in getting quick delivery from the United States."

The 160 hp engine with its constant speed propeller has been certified at the same weight as the previous 135 hp engine with fixed pitch.

Rotary Alternator

The Micromin rotary alternator, designed and developed in England by British Nuclear, Ltd., an associate company of Coop Culture, will be standard equipment on the Workmaster. Each aircraft is fitted with two of these alternators, one on each wing. Space economy is fact from the electrical load in the fuselage to the alternators.

The firm says that an unorthodox work it is possible to cover an acre with only legal of spray using the atomizer and that it is efficient in spraying for about 2 gal. an acre in any other type of work.

Aviation now there is no yet no top-downing version of the Workmaster but that such an aircraft will follow. It is also considering the possibility of modifying the Workmaster for passenger and mail carrying. The two hatch, designed for removal of the chemical tank for cleaning or overhaul, would admit passengers up to 13 in. by 24 in.

Coop Culture plans to order for the

Workmaster at the end of last December, and the first aircraft flew only 55 days later. The aircraft spooling and top-downing, company began operations in 1975 using converted de Thuisland Tiger Moth biplanes. It now has a fleet of over 10 aircraft in use or on order. It operates not only in the United Kingdom but also in the Sudan, North Africa, Mauritania, British and French West Africa.

In the six months ending December, 1977, the company spent over a quarter of a million pounds in the Cameroons. It maintains a permanent base in the center of the African business growing area.

USSR Light Twin Attains 143 Mph.

Aviation designed An-14 (Pobeda) (La-14) light twin using short haul aircraft has top speed of 143 mph and range of 150 mi. carrying six passengers and 110 lb. of baggage in stage, without Russian sources received.

Two Proflin six, endogenous flight test and an agricultural version is being built. Especially designed to operate from unprepared fields, plane is powered by two Ivchenko AI-14B radial engines. Instrument panel is oriented to include radio direction, engine, radio altimeter and other weather equipment.



HE'S FLYING THE NOSE SECTION

An adverse accumulation of tolerances can ruin an engine. Every part must be within the manufacturer's wear limits. Yet, when the engine has been assembled, the oil flows are not acceptable.

The condition is always caught at Final Test. But that is the expensive place to find it. The trouble could be in the nose, the rear, or the power section.

This Airwork designed rig checks

each section before Final Assembly, tests oil oil pressure and temperatures, and is operational conditions.

By flowing each section to Airwork's own limits, we know performance will be satisfactory on Final Test. And, since every passage has been packed with oil in the shop, we know the engine gets maximum lubrication at all vital points.

Send your next engine to Airwork where careful craftsmanship produces better engines.

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CAPABILITIES . . . Manpower, Tools and Experience



Rugged and Right...Will Travel Anywhere

Beechcraft performs with small aircraft landing field capabilities—these factors make the Beechcraft L-38D the finest in Army Aviation! This new Beechcraft is **also** too. With the jettisonable engine, and low-wing structure "meeting interference" for the occupants in case of a forced landing, there is only **4% per cent** of the weight of the airplane above and behind them!

Thirty-four inches of ground clearance make the L-38D one of the best operating planes in and out of small fields. Also, there's the **availability** factor. The L-38D has the lowest "down time" of any airplane in its field. In other words, it's **designed** and **built** to be useful!



The L-38D is just one of four different types of airplanes now being produced at Beechcraft. Other projects include advanced research and development into the fields of monster and target aircraft, engineering test programs as aircraft emergency escape systems, and classified projects in the advanced fields of aerodynamics, ergonomics, thermodynamics, and aircraft range extension.

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Flight Safety, Inc., LaGuardia Marine Terminal, installed Space integrated instrument systems in its flight simulator used by corporate pilots for checking instrument flying procedures. That aircraft has a Collins integrated flight system and standard subtransmission.

Aerol Missions/Aviation Air Cruise May 10-14, for private pilots is designed around an all-expense package tour costing some \$40 plus hotel rooms, which are offered at special low rates. Program encompasses sightseeing trips to Moscow and St. Petersburg, a tour of the Soviet Union, 3-4, planes will land at new Moscow Airport, Moscow, which will be dedicated during the tour. For details, write James G. Pratt, cruise director, 318 S.E. 2d Ave., Miami.

USAF's first class of primary students to fly jet trainers graduated at Ames Air Base, Ga., March 14. Class, planned to prove the Concept T-37A's performance in the training course, had only 10 hr. previous flying time in piston-engine Beech T-34As before they went into T-37As. Each student received 118 hr. total flying time in this experimental phase, much of which could be done with 100 hr. flying time. Student workload and flying grade were also higher than normal, indicating higher motivation than in



Export Via Air

Piper PA-16-A Super Cub approved as plane, one of a two designed for Wiles and Germany, is offloaded from a Seaboard & Western Airlines' Super Cub transport at Shannon Airport, Ireland, with assembled and flown every two days into Seaboard & Western reports it has been accepted as one of the first planes available to Europe in past year in addition to a total of a half-dozen helicopters.

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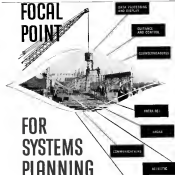
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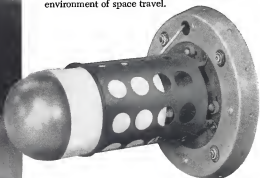
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Elastic stop nuts... *make first trip to the exosphere*

What were the requirements for an exploratory trip into the exosphere? The success of project Far Side established these two among others:

1. A launching platform located as far as possible above the effects of atmospheric drag
2. The use of hardware of proved ability

Some of this hardware can be seen in the close-up of Far Side's nose-mounted payload. In the photo showing the payload before the nose cone was placed over it, three of the four Elastic Stop nuts used to secure the third stage rockets to a retaining ring are clearly visible. They are standard ESNA hex nuts—with the familiar red nylon insert. These are the self-locking fasteners that have proved their ability to hold tight under the severest requirements of aircraft operation, through almost three decades of progress in aircraft design and construction. And now they have proved their ability to meet the requirements and unusual environment of space travel.



The complete line offered by ESNA includes self-locking nut designs for every missile, aircraft and power plant application. They cover a range of operating temperature requirements from -80°F . to over 1300°F . For specific information, send the details of your application to ESNA.

Write to Dept. S17-425, The Elastic Stop Nut Corp. of America, 2330 Vauxhall Road, Union, New Jersey



**ELASTIC STOP NUT
CORPORATION OF AMERICA**

An artist's version of the launching of the Far Side rocket. The four-stage vehicle was carried to an altitude of 100,000 feet by a polyethylene balloon made by General Mills. Fired straight up through the balloon, Far Side rocketed to the greatest distance from the earth ever reached by a man-made device. The prime contractor for the Far Side project was Aeronautic Systems, Inc., a subsidiary of the Ford Motor Company, for the Air Force Office of Scientific Research (ARDC).